

**The Introduction of a  
Quality Assurance System  
into a Jobbing Workshop.**

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Andrew Shaw B.E.**

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Department of Mechanical Engineering  
University of Canterbury  
Private Bag, New Zealand.**

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## Abstract

This thesis details the introduction of a quality Assurance System into a Jobbing Workshop. Previous to the beginning of this investigation the company had had little exposure to the use and benefits provided by such systems.

A Quality Assurance System was designed and implemented in the factory following an initial investigation to determine the companys requirements. The Quality System was then audited to assess it's conformance to National Standards. The writer then investigated aspects of the system highlighted by the audit.

## Introduction

This Thesis details the development and implementation of a Quality Assurance (Q.A.) System in a Christchurch company, Mace Engineering Ltd. It relates the reasons behind the decision to implement a Q.A. System, how this system was designed, then modified to meet the needs of customer and client followed by details of the system's implementation and final audit.

As Q.A. is still a relatively new concept in the production and service industries of New Zealand and, to date, many myths about this subject are prevalent in the workplace the writer investigated the concept of Q.A. and in particular the following questions were asked:

1. What is Q.A.?
2. Why is it needed?
3. How is it implemented?
4. Who should implement it?
5. When should it be implemented?

These questions were investigated in two ways. Firstly the internal relationship between the Q.A. System and the Workplace was examined and secondly, the interrelation between Q.A. accreditation and it's effects on customers, suppliers and, in a broader scope, the effects on the nation.

Having considered the Q.A. System, it's definition, uses, method of deployment and reasons for implementation the student then addresses the implementation of such a system at a local company. In this section the "problem" and restraints are identified leading to the choice of standard and Q.A.System. The method of implementation is then considered, finalised and followed by details of the creation, implementation and auditing of the system itself.

The writer will then proffer observations, conclusions and recommendations on the implementation of a Q.A. System in a Jobbing Factory.

## Chapter One

### 1.0 What is Quality Assurance?

Quality Assurance: All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality. (ISO 8402: 1986)

It follows from this definition that a Q.A. System is one that "details the organisational structure, responsibilities, procedures, processes and resources necessary to ensure that a product or service has the desired degree of quality acceptable to both customer and client."(NZS 5600:1986)

The evolution of Q.A. Systems can be traced to the period immediately following the Second World War. During the war emphasis on the factory floor was on production and numbers. Quality was not good in most cases due to the processes, materials and technology. However, the method used to ensure quality of a finished item was to employ increasing numbers to remove defective products before they left the factory. It was during the Post War period that the emphasis on quality changed from inspection to the identification of causes of quality problems within the production system. This change of emphasis and the creation of methods to identify quality problems was the domain of Messrs Juran, Deming and Crosby.

Middle management continued to be the mainstay of the quality function, investigating programmes to identify and amend quality problems. Quality assurance was required more and more as the producer was not only required to produce a high quality product (in the sense that it conformed to the customer's requirements) but be able to provide proof that this was so. This was important because, as the expected life-time and complexity of products grew, reliance on the manufacturers reputation and testing evidence was not sufficient: "[they], fail to guard against inadequate product designs, process designs and quality planning which are present at the very outset of a project and can thereby lose years of time and effort ... They fail to deal with those aspects of quality performance which show up after final test, Eg. packing, storage, usage and maintenance".(Juran 1974). The tools to provide these assurances ( audits, reviews and formal plans) could only be provided by upper management.

These prerequisites for assurance have made up the framework of the modern Q.A. System. They have resulted in a number of recognised standards that specify how a Q.A. System is to be ordered and are, in themselves, a document defining the level of Q.A. between the customer and producer. The responsibility for quality now lies completely with upper management. Current thinking assigns decreases in quality to management's inability to define the " organisational structure, responsibilities, procedures,

processes and the resources necessary to ensure that a product or service has the level of quality acceptable to both customer and client."(NZS 5600: 1986)

### 1.1 Why do we need Quality Assurance?

It is inherent in the deployment of a new system, code etc. that it's introduction will bring about change and (supposedly) improvement or benefits of some type. Thus the reasons for the introduction of a Q.A. System both internally and externally in a factory need to be addressed. The New Zealand Organisation for Quality (NZOQ) suggest that " By making the product 'Right First Time' and not having to inspect defects out of production, the savings are considerable and the co-ordinating and cohesive effects of a Q.A. System will improve morale and productivity".(NZOQ: Issue 84).

This statement shows the major reasons for the introduction of a Q.A. System. The benefits from improvement in quality due to improved company communication and understanding include:

- better recognition and understanding of problems, leading to:
  - less scrap and rework, giving:
  - more efficient production of a product or service.
- leading to increased market share and profit.

Thus "an effective quality management system

should be designed to satisfy customer needs and expectations while serving to protect the company's interests". (ISO 9004: 1987). Externally, in the marketplace, as Q.A. Systems are becoming more accepted and as their worth is documented they also become more prevalent. Market forces dictate that other companies must also employ such a system in order to remain competitive.

Presently, New Zealand companies lag overseas competitors by approximately five years in the drive to set up Quality Systems. It is in this country's best interests to set up proven quality systems in light of these international developments. In 1992 the United Kingdom joins the European Economic Community (EEC). The EEC is presently implementing a strong quality drive which will deprive those New Zealand Companies without Quality Systems of access to traditional markets.

Closer to New Zealand shores, the ANZAC Frigate project, with over \$400 million to be allocated to New Zealand companies, is being undertaken. Amecon, owned by the Transfield Engineering Group and working with Blohm and Voss of Germany, has placed a high priority on the existence of certified Quality Systems in the awarding of tenders for this project.

A third reason for the introduction of Q.A. Systems is the increasing depletion of the world's resources. It is imperative in this technological age that resources consumed

should not be wasted. A properly designed Quality System seeks to reduce scrap, wastage and inefficiency and to make fuller use of resources.

## 1.2 How is a Quality Assurance System implemented?

Once the decision to implement a Q.A. System has been made the company must design a system that reflects it's aims and beliefs. There are two choices. One, an internal quality system for their own benefit or two, an external quality system that is recognised by customers and competitors alike. Choice two is usually the preferred option.

The Standards Association of New Zealand (SANZ) sets down the minimum requirements for a Quality Assurance System Model in it's 5600-1987 series of standards. These standards are equivalent to the ISO 9000-1987 series of standards.

The aim of the standards is:

- " (a) To provide a customer with the assurance that a quality product or service will be supplied
- (b) To give the supplier the minimum guide-lines to allow the development of an appropriate quality management system which can demonstrate product or service quality assurance to the customers."

(NZS 5600 Pt2:1987).

Three standards within this series represent the diminishing complexity of Q.A. Systems to meet the broad

areas of production and service industries.

1. NZS 5601/ISO 9001      Quality systems- A model for Q.A. in design/development, production and servicing.
  
2. NZS 5602/ISO 9002      Quality systems- A model for Q.A. in production and installation.
  
3. NZS 5603/ISO 9003      Quality systems- A model for Q.A. in final inspection and test.

These Standards detail a list of up to twenty three elements which are considered essential for a Quality Assurance System. They must be satisfied by the company's management, organisation and procedures before accreditation to that standard is considered. Each organisation may decide how to design a system to satisfy these elements but it must be accredited by an independent organisation to show it has fulfilled them.

### 1.3      Who implements the Q.A. System?

Within the company there are three tiers that are important to the implementation of a Q.A. System:

1. Top Management-      The people who have the power

to implement the system.

2. Middle Management- The people who organise and implement the system.
3. Workforce- The people who have to work within the system.

The responsibility of implementing a system lies ultimately with the top management, (the term top management refers to those people who report directly to shareholders, board of directors, etc.) without their support (and being seen to give support) any system such as this will lack cohesion and will ultimately fail. This is because the workforce needs to see a commitment to, and support of, the principles introduced before they will adopt them.

Second level in the tier is the Q.A. Manager who will ideally have the same authority as the Production or Works Managers. This is important as the Q.A. Manager must have the authority to implement quality directives, if (s)he is outranked by the Production Manager quality will take a backseat to productivity.

Third level in the tier is the workforce. They put into practice the quality directives of management. Any quality improvements however, will fail if they are badly designed, the workers are insufficiently trained or there is lack of support from management.

Throughout the country the occurrence of Quality Systems is becoming more prolific. Not only are more manufacturing and production industries adopting Q.A. principles and systems but service industries such as hospitals are beginning to introduce these principles. Ultimately, any organisation that produces a good or service may implement such a system.

## Chapter Two. Description of the O.A. System

### 2.0 Description of the company

Mace Engineering Ltd., a subsidiary of the Mace Group Of Companies, is best described as a general engineering and jobbing workshop.

The premises, situated in a central industrial area of Christchurch, is readily accessible to the public and incorporates several of the Mace group of companies on site. The engineering workshop employs a staff of approximately 85 persons split into several departments:- administration, design, programming, production, stores and inspection.

The company has a wide range of engineering plant and machinery consisting of milling, grinding and turning machinery, spark erosion and gear cutting facilities as well as CNC machining and cutting centres. The machine shop is able to produce a variety of work from light engineering and fabrication through to heavy engineering with work pieces up to 40 tonnes, 6 metres in diameter and up to 12 metres in length.

The company generates work in three separate ways:

1. Customers approach Mace Engineering to complete a job for them. Mace Engineering has an "open workshop" policy where Works Managers are readily accessible to the customers to discuss work.

2. Through the production of purpose built machinery. Mace Engineering makes products under licence from various companies as well as marketing a range of their own products. Products designed by the company are marketed through the sales team.
3. Mace Engineering tenders for a wide range of contracts involving the design, production and installation of various work. The scope of the work is wide due to the diversity of equipment available on the premises.

Each Works Manager is responsible for his own purchases, production and despatch of orders using the machinery and manpower allocated to them. If a Works Manager lacks the facilities in his own area cooperation between Works Managers is necessary to complete a job.

### **2.1 Selection of a Quality Assurance System Standard**

The selection of a suitable Q.A. System was governed by several factors. The decision to implement a Q.A. System was made by the Managing Director. The main impetus behind the decision was the need to have a functioning and accredited Q.A. System "up and running" as soon as possible to be able to tender for several large Australasian contracts. The need to have an internationally recognised system accredited by a recognised authority dictated the choice of Quality System.

The Q.A. System chosen had to reflect the nature of the work being produced as well as being suitable for two party contractual agreements. This is opposed to an "in house" Q.A. System not suitable for contractual agreements. As the products manufactured were to be certified to a recognised standard the choice of standards was limited. Eliminating standards of those trading partners which made up the minority of the work, the choice was narrowed to:

1. NZS 5600-1987
2. ISO 9002-1987
3. BS 5750.

Closer examination of the standards revealed few differences (in fact, the British standard was the original and the ISO and NZS series adapted from it). The International Standard ISO 9002-1987 was chosen for it's broader appeal to overseas customers.

The ISO 9000 series of standards are made up of two distinct parts. ISO 9000 parts 1 and 2 being guide-lines for the selection and use of Quality Management and Quality Assurance standards and elements while ISO 9001-9003 gives models of the actual quality systems.

ISO 9001 Model for Q.A. in Design/development,

Production, Installation and Servicing.

ISO 9002 Model for Q.A. in Production and Installation.

ISO 9003 Model for Q.A. in Final Inspection and Test.

As the main purpose for initiating a Q.A. System was to gain contracts for production ISO 9002-1987: A Model for Q.A. in Production and Installation was chosen as the standard to which the company was to be accredited.

ISO 9001-1987 was to be achieved at a later date.

Once the choice of standard had been finalised, an accreditation agency, to work with Mace Engineering during the implementation and audit of the system, had to be selected. Currently there are only two New Zealand based recognised accreditation agencies, namely TELARC, based in Auckland and SANZ, the Standards Association of New Zealand. The DSIR and several other private agencies intend gaining recognition in the near future.

The consensus of Mace management was that a New Zealand based accreditation authority would not have the same appeal to overseas customers as an internationally recognised body. The decision to appoint the only such body available in New Zealand was made and Lloyds Register was chosen as the Quality Assurance Systems Auditor for the company.

## **2.2 Implementation of the Quality Assurance System**

With the choice of Standard and Auditor finalised, the next step was to design and implement the Q.A. System itself based on 1) the guide-lines of the chosen standard and 2) the specifications of the company.

Two methods of implementation were considered. The first was to design the system and the manuals and procedures needed to support it. This information could then be combined into a Quality Assurance Manual. Implementation of and training for the system would then commence using the manual and suitable test cases in the form of work orders.

The second method considered was to upgrade the factory to the requirements of the standard in stages. That is, decide on the system, select an area of the factory and then identify and implement all work to be done to bring that area within the guide-lines of the standard. Each area would be documented as necessary with work procedures. The implementation of the Q.A. System would then proceed progressively through the rest of the factory. This would culminate in the writing of the Quality Assurance Manual.

The second method of implementation was chosen because it offered several distinct advantages over the first.

1. Rather than have the whole factory change over at once the system could be phased in to gauge performance.
2. Information gained in organising the initial areas of the workshop could be used in implementing the Q.A. System in the rest of the factory.
3. Using an on going programme of implementation, the employees and management would start to become interested at the beginning of the programme and

provide additional information and feedback.

4. Implementation of new work practices at the beginning of the programme would provide a longer run in period. Thus difficult or complex areas could be targeted and the information/experience used to a fuller extent later in the programme.

### **2.3 Design of the Quality Assurance System**

The ISO 9002-1987 standard specifies the requirements necessary for a company to gain accreditation. Mace Engineering therefore had to find a balance between the (quality) requirements and the company's own quality, organisational, cost and staffing requirements.

Mace Engineering's primary specification was that the Quality Assurance System would only be used for large tender and contract work. All current jobbing work would continue in the present manner. The rationale behind this was that the ordinary customer with smaller work did not require the "Quality Assurance" that larger jobs did. Also it was thought that trying to implement a Q.A. System would result in an unacceptable amount of extra work, the increased workload resulting in an increased cost for the customer.

As the ISO 9002-1987 standard could not be applied to only part of the workshop the concept of a two tier system of Quality Assurance within the factory was decided upon by management. One level for large contracts and a lower level

for common jobs.

### Chapter Three. Quality Assurance System Implementation

With the scope of the Q.A. System finalised the priority for implementation of the system in the separate areas of the workplace was defined. The order in which the separate areas of the system were to be introduced was determined as follows:

1. Inspection, Measuring and Test Equipment.
2. Purchasing.
3. Inwards Goods.
4. Process Control and Non Conforming Material.
5. Documentation of the System.

A Q.A. System newsletter was created prior to the implementation of the programme to inform staff of the introduction of the Quality Assurance System. This newsletter was produced monthly to inform staff of the changes and impact that it would have on their workplace.

#### **3.1 Inspection, Measuring and Test Equipment**

This area was chosen to be the starting point in the introduction of the Q.A. System as it was common to both proposed tiers of the system.

Previously, any inspection or test equipment (micrometers, gauges, rules, verniers and the like) were brought to the Quality Control inspection bay for calibration on one of two occasions. Either the operator

suspected their inaccuracy or, they were checked before starting a job requiring the use of an accurate measuring instrument. Both occasions were at the operator's discretion.

There was no system to ensure that the measuring equipment was regularly and correctly calibrated. In addition to this, records were not kept of such calibrations and each piece of equipment was not uniquely identifiable ( although some equipment was marked with a unique number this was not the case for all items ). The actual numbers of equipment on the premises was not known ( it was speculated that between one and three hundred micrometers were in use ) and neither the method of calibration nor the accuracy to which the equipment was to be calibrated were known.

In order to control, calibrate and maintain the equipment in line with the recommendations of the Q.A. Standard ISO 9002-1987 the following reforms were introduced.

1. All micrometers and verniers (these made up by far the majority of inspection and measuring equipment) were given a unique Mace Identification Number. This number was engraved on the instrument and on the box in which it resided.

2. A Mace Engineering Equipment Inspection Sheet was created (Appendix B) and each piece of test, measuring and inspection equipment on the premises had it's data recorded on a sheet. Each sheet listed:

1. Equipment description
2. Brand name
3. Mace number
4. Model number
5. Serial number
6. Purchase date
7. Supplier
8. Workplace or person assigned to
9. Calibration history and record of test.

As each piece of equipment was recorded it was checked as specified in the appropriate British Standard and, if necessary recalibrated in accordance with standard procedure. Each calibrated instrument was marked with a coloured adhesive Label to designate completed inspection.

3. In order to ensure the continued calibration of test equipment a calibration system was set in place. All calibrated equipment was marked with a coloured sticker upon passing inspection as above. In prominent areas around the factory large painted squares were hung. They were painted the same colour as the stickers on the inspection equipment. Every six months all test equipment in general use is recalibrated and marked with a new, differently coloured sticker to distinguish it from unchecked equipment. The painted squares are then changed to the new colour. Test equipment which does not have a sticker that matches the colour on the wall is immediately quarantined until such

time as it can be checked.

This system ensures that all equipment in general use is regularly calibrated and maintained. Equipment that is used infrequently and equipment in general use with suspected inaccuracies is checked by the Q.C. department before use. This data is recorded on the Inspection Sheet. A more comprehensive description of this system can be found in Appendices A and B.

### **3.2 Purchasing**

The choice of the Inspection, Measuring and Test equipment being incorporated into a calibration system as a starting point for the introduction of the Q.A. System was not arbitrary, as it encompassed both levels of the proposed two tier system. It also helped to highlight to the workforce that changes were underway.

Once this initial target had been achieved the implementation of the Quality system proceeded in stages following the movement of goods within the factory. The logical place to start being the purchasing system.

In line with the two tier approach a separate purchasing system was set up for the "Q.A. Jobs", as they were now known. This system was to run in parallel with the present purchasing system.

The purchasing system for "Non Q.A. Jobs" consisted of Purchase Order books which were issued to Works Managers and Departments Eg. Stores. These were used to obtain goods and services. Individual holders used their discretion in what they ordered and who they ordered from based on:

- experience
- price
- catalogues
- customer suggestions
- telephone directory
- memory

The orders reached the suppliers by faxsimilie, phone, mail or were delivered by hand.

The "Q.A. Jobs" required that all purchase documents contained data clearly describing the product ordered. Each order was reviewed for adequacy and content before it was sent, the supplied product was verified (dealt with in section 3.3) and suppliers were vetted to assess their ability to supply to adequate product quality levels.

Hence a system was designed to satisfy the requirements of the "Non Q.A. Jobs" and of the "Q.A. Jobs". A flowchart depicting this procedure is detailed in Figure One. A full description can be found in Appendices A and B. The procedure is in two parts. Firstly, the job is identified as "Q.A." or "Non Q.A." work. For "Non Q.A." work material may be sourced from the common store or, if cost permitted from the separate "Q.A. Store" (the added cost due to the extra documentation, planning, testing etc. needed to assure it's

quality). If the job was designated "Q.A." and if material was not available from the "Q.A. Store" it was ordered in the following manner.

The Works Manager filled out a Purchase Requisition Form (PRF), detailing any or all of the following attributes:

- material specification
- warranties
- test and mill certificates
- quantity
- delivery instructions
- inspections necessary
- suggested supplier
- special criteria.

The PRF is then forwarded to the purchasing officer who selects a supplier from a list of approved suppliers who have satisfied Mace Engineering that they can supply the goods. If no supplier can be found the PRF is returned to the Works Manager who, in conjunction with the Quality Control Department, devises a test programme to ensure that a product sourced from a supplier can be assured to the specified quality level. The PRF is then returned to the Purchasing Officer who prepares and sends a Purchase Order. The completed Purchase Order is sighted by the Works Manager as part of the review process.

Once a system to order goods had been planned and approved the system was created This involved organising the order forms, PRFs, construction of the "Q.A. Store", and

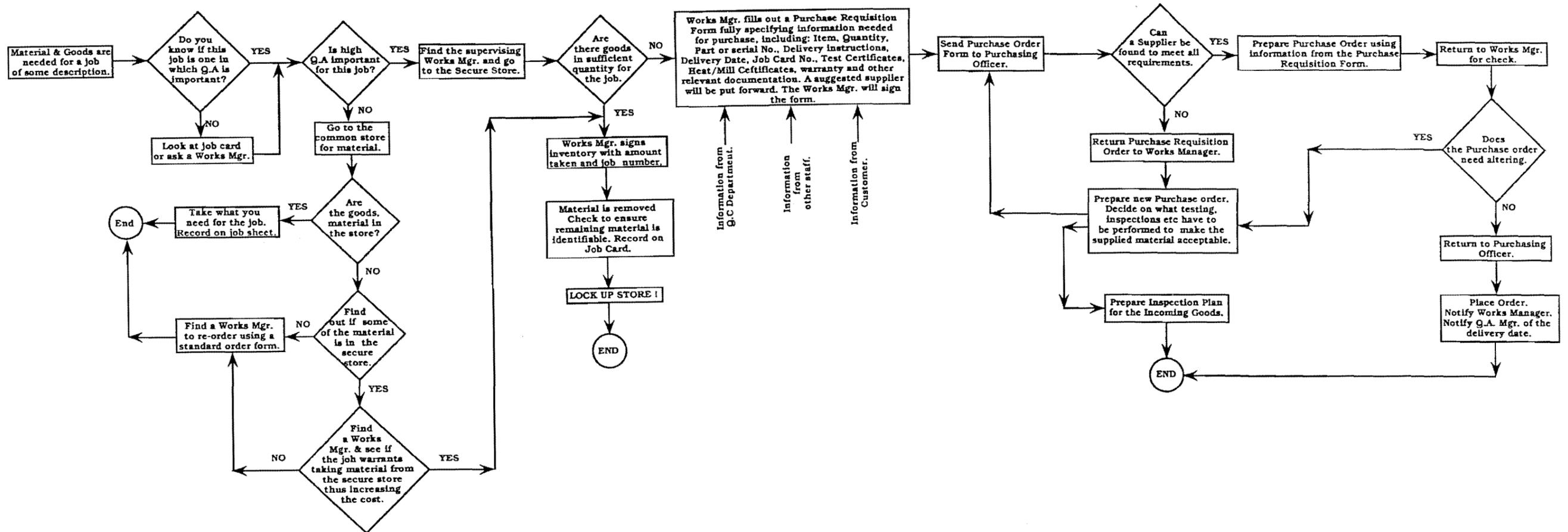


Figure one: Flowchart Depicting Ordering Of Goods.

the writing of the procedures and flowchart. The system was then introduced to the shop floor.

The next step to be addressed in the factory was the Inspection, Testing and Storage of purchased goods.

### **3.3 Inwards Goods Inspection, Test and Storage**

Mace Engineering Ltd. covers a large floor area and has numerous entrances and exits (notably marked 1 through 10 with additional doors as well). Goods delivered to the premises would be delivered to the most convenient point for the delivery agent. There was no designated Inwards or Outwards goods delivery areas. Once an item was delivered it was the responsibility of the person who worked in that area to ensure it reached the correct department. This was more complex than it seems as not always were delivery dockets and packing slips enclosed. Also, no inspection of the delivered item was made to ensure it conformed to what was ordered.

Management decided to leave the incoming goods procedure as it stood for those items ordered for "Non Q.A. Jobs" as well as for the delivery of all consumables purchased for the workshop. A system to ensure that those items purchased for the "Q.A. Jobs" met with the provisions of the standard was then devised.

All purchase orders for "Q.A. Jobs" stipulated that deliveries of items were to be made to Door Number 4, Wilmer Street entrance. This was to ensure a common delivery point that would have the facilities for heavy lifting as well as a vehicle entrance. In the event that a delivery was made to another entrance a system was devised to ensure that goods were re-routed to this entrance. (See Figure Two).

Upon delivery to this area the Q.C. representative performed an Incoming Inspection on any items. The inspections to be performed were decided upon when the item was ordered.

The Q.C. representative then completed an Incoming Inspection Report as documentation of the inspection. If the item passed inspection it was issued with a green tag bearing the legend "USE THIS MATERIAL ONLY" and was then transferred to the secure store to await use. If the material required more inspection or documentation was missing (eg. test certificates) the item was issued with an orange tag "HOLD, AWAITING INSPECTION" and transferred to the secure store until the documentation arrived or the inspection was performed. In the event of an item failing inspection it was issued with a red tag "REJECT" and was quarantined so it could not be used. All tags issued to the incoming goods bore the following information:

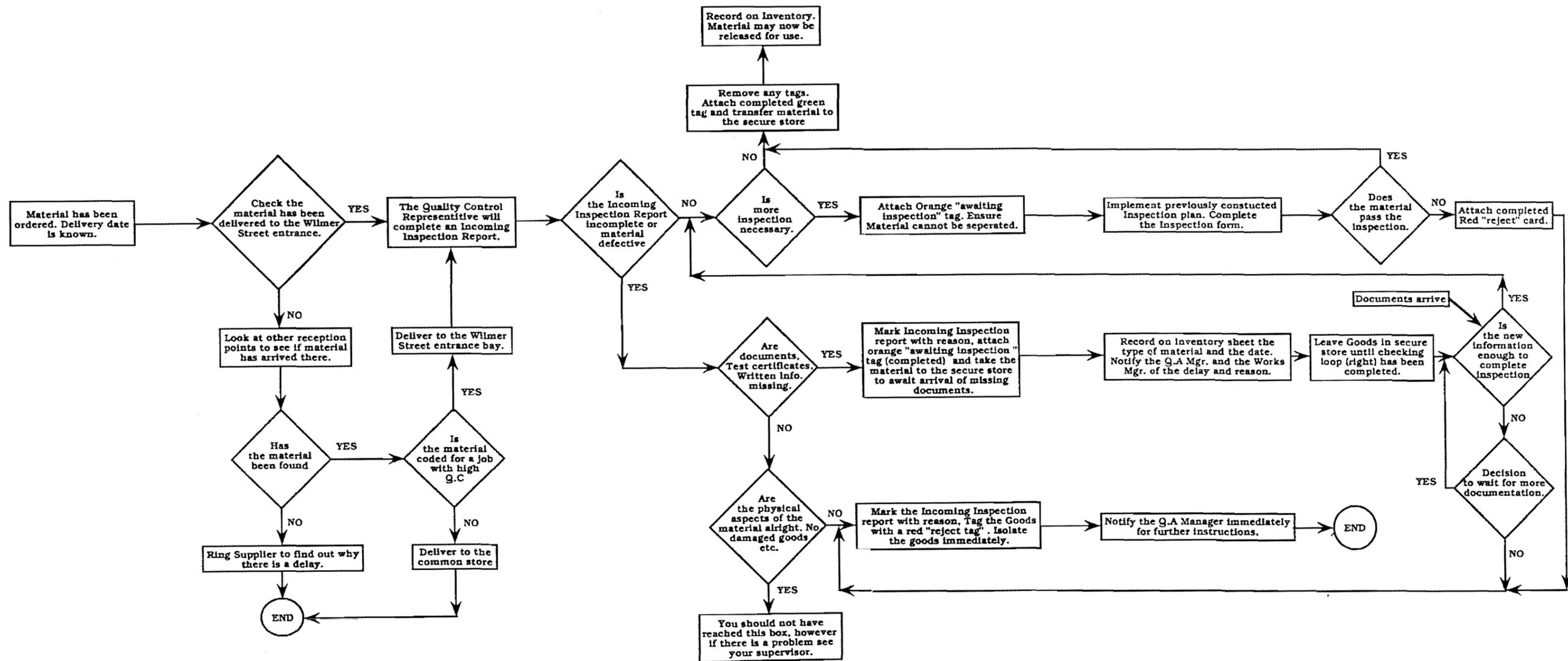


Figure Two: Inwards Goods Procedures.

1. Department which ordered the material
2. Date Inspected
3. Inspection Report Number
4. Job Number
5. Inspectors signature.

Upon the completion of this system, which ensured that all material incorporated into a job conformed to specifications, the next area addressed was the manufacture of customers orders. That is, the way in which customer orders were processed to ensure that the finished item conformed to customer specifications.

#### **3.4 Manufacturing Control**

In the formulation of a documented system for manufacturing control it was realised that existing practices within the factory were sufficient to control the manufacture of an item. However, the supporting documentation was insufficient to ensure production was carried out under the controlled conditions defined in the standard ISO9002-1987. This was especially apparent in terms of traceability of manufacture.

The documentation of procedures for:

1. Pre manufacture planning
2. Manufacturing control
3. Defect control and corrective action

needed to be addressed for that work designated "Q.A. Jobs". These procedures needed to reflect the increased need for

the traceability of the job, more comprehensive planning and the control of any corrective actions.

#### 3.4.1 Pre manufacture planning

The large amount of varied work produced in the modern jobbing workshop dictates the type of quality planning that must occur. In a mass production environment the process can be set up and then "fine tuned" by further planning to ensure the quality of the product. This is not the case in a jobbing workshop where the percent repeat rate of work is not high. In this environment the emphasis must be on planning the manufacture of the job so that it is "right first time". Second chances do not exist; rework is costly, time consuming and detrimental to profit margins.

Mace Engineering were using a "Job Card" (see Appendix A) which listed the following data pertinent to the workshop:

1. Customer name and address
2. Job number
3. Date promised for delivery
4. Contact name
5. Work description
6. Work instructions.

Upon receiving a job these details were noted and the Works Manager in charge of the job would write a description

of the work and the process plan. The job card then followed the workpiece from station to station accompanied by any drawings and samples. More frequently, any process instructions given were oral and depended on the Works Manager's and the Operator's memory to ensure that the correct tools, methods and procedures were used.

There were no recorded detailed instructions of what to do, how to do it, what tools to use and what inspections were necessary to ensure the correct completion of the job. To improve the quality of communication and of work produced and to satisfy the requirements of traceability a "Job Instruction Plan" and a complimentary "Job Inspection Plan" were introduced. (See Appendix A).

The Job Instruction and Inspection Plans are completed by the Works Manager in charge of a job in accordance with a defined procedure (Appendix B Procedure P001 and P002). They list the work to be done, the tooling required, the machine it is to be produced on and the order in which work is to proceed. All points where quality could be affected are addressed including the required level of workmanship and tolerances to be met. The drawing number and revision to be used are noted. Inspection points are clearly noted and criteria to be achieved in that inspection indicated. A column is provided for the machine operator to sign and date signifying that a particular task or inspection has been carried out. Work cannot proceed beyond a given point without this signature. It was decided to introduce the use

of Job Instruction Sheets for both "Q.A. Jobs" and "Non Q.A. Jobs" as they were found to be useful in conveying instructions to workshop staff. For the Q.A. Jobs the sheets were planned more extensively detailing all information necessary for the completion of the job. (See Figure Three). For Non Q.A. Jobs where instructions were minimal these instructions could be recorded directly on the Job Sheet.

#### **3.4.2 Manufacturing Control**

A package concept is used to ensure control and traceability of a Q.A. Job during manufacturing. A clear plastic folder accompanies the job from workplace to workplace during manufacture. It contains:

1. Job instruction plan
2. Job inspection plan
3. Drawing
4. Job card
5. CNC machining set-up sheet.

Thus at any stage of the production process all information is available and accompanies the job. For the Non Q.A. Job the package would normally consist of a drawing and job card.

#### **3.4.3 Control of Non conforming Material**

Detection of a non conformity (in material, during manufacture) in a job through inspections, operator

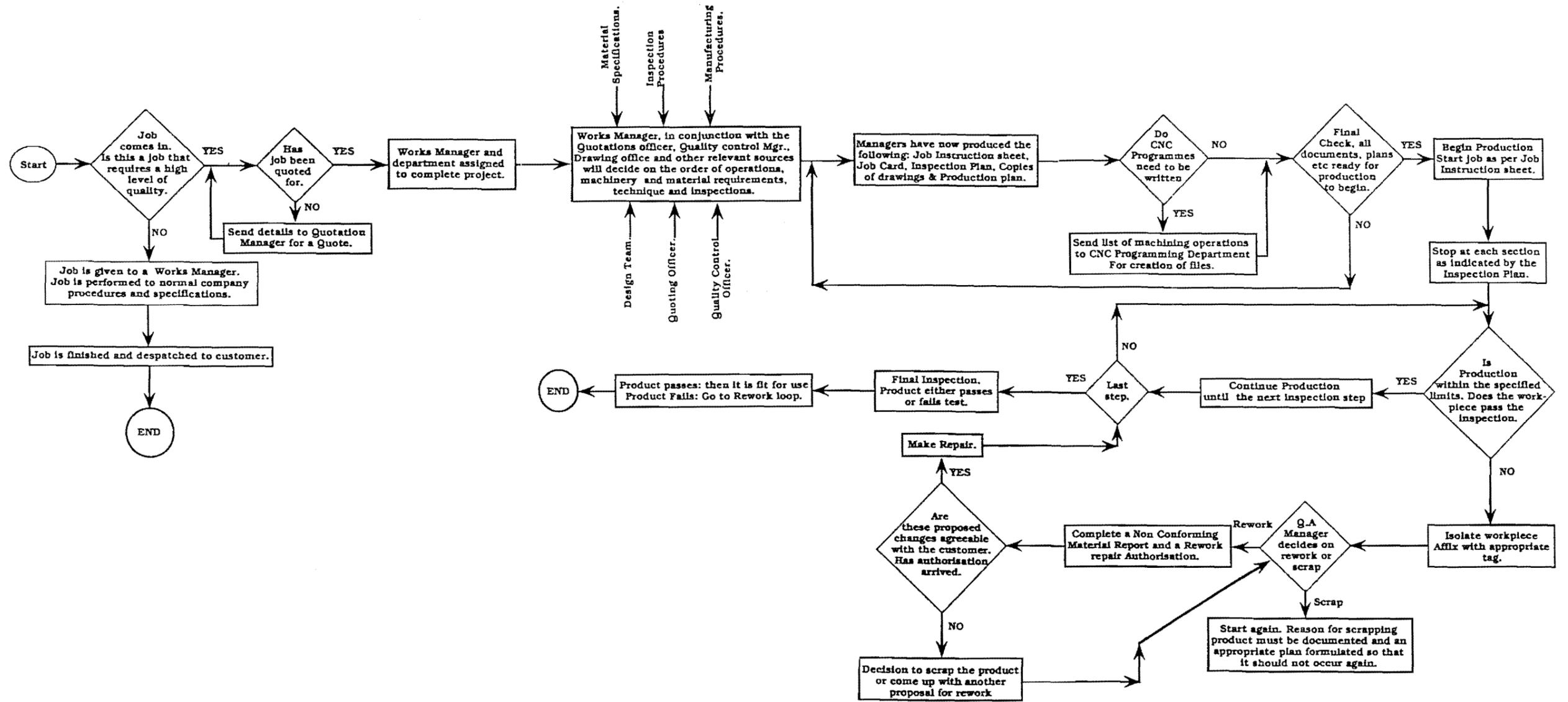


Figure Three : Production System.

vigilance or customer notification is an area of quality control that had to be addressed. Three activities had to be fulfilled in order to control a defect and meet the requirements of the standard. Firstly, the defect must be adequately identified and removed from the system. Secondly, the type of the defect must be classified and a decision made to rework, repair or scrap the item. Documentation must be provided to record whichever action is taken. Thirdly, the reasons for the defects occurrence must be investigated and this data fed back into the Q.A. System as an aid to eliminate further defects of this type. A set of procedures was devised to meet these needs. Figure Three details the procedures to be followed when a defect is identified.

Appendix A details the Non Conforming Material Report and Rework/Repair Authorisation that are to be completed and recorded in the job file. Instructions on these documents ensure that the defect is isolated from the manufacturing system until a decision has been made by the Works Manager regarding what to do. Should the Works Manager decide the defect can be reworked or repaired the customer is notified of the proposed change by the use of the Rework/Repair Authorisation. Upon receipt of the authorisation the rework is carried out. When jobs are completed the Non Conforming Material reports are collected and the Q.A. Department holds a "Post Mortem" to determine any likely areas of quality improvement.

### 3.5 Documentation

The documentation to describe this system falls into two categories:

1. Documentation needed to run the system
2. Documentation needed to describe how the system operates.

The documentation needed to run the system was created as each area was addressed and updated to meet the Q.A. criteria. This was detailed earlier in the chapter and a full listing can be found in Appendix A.

The documentation to describe how the system operates was created after all the areas had been updated and consisted of three tiers:

1. Quality Manual- Company policy and system outlines.
2. Procedures manual- Defines how the policy is carried out.
3. Work instructions- Defines how specific tasks are carried out.

#### 3.5.1 Quality Assurance Manual

ISO 9002-1987 section 4.2 suggests that "timely consideration be given to the preparation of a ... Quality Manual". The first tier in the quality documentation is the quality manual which lays out the company policy towards

Quality Assurance and how the company sets about achieving these goals. The writer prepared the Quality Assurance Manual after the completion of the implementation of the system and thus the company's policies towards quality were known and hence easily documented. Each major area where quality assurance procedures were implemented was addressed in the manual.

The Manual was constructed using a word processing package for the text and page outlines. A specific page format was designed for uniformity and ease of administration and change (the issue date, page and revision numbers, title and authorisation are featured). The Manual was then bound and distributed within the company and to customers upon request. It is becoming quite commonplace for companies to be asked to provide copies of their Q.A. Manual when tendering for work. A copy of the Q.A. Manual is featured in Appendix A.

### **3.5.2 Quality Assurance Procedures**

For each area of the factory a procedure was documented using a standard format and detailing the following information:

1. Introduction
2. Scope
3. Objectives
4. Timing of the implementation
5. Responsibilities

6. Method
7. How the procedure is checked
8. Storage of documentation.

Examples of these procedures are detailed in Appendix B. The procedures were written in the following manner. The writer interviewed the Works Manager in charge of the area whose procedure was being prepared. Each of the topics above were discussed and a procedure was prepared from these notes. The procedure was then submitted to the Works Manager for approval. Upon approval being gained the procedure was reviewed and issued by the Q.A Manager. They were collated into a Quality Assurance Procedures Manual. At that time the Works Managers were encouraged to write work instructions for repeatable jobs under their control.

The procedures and work instructions are distributed within the factory and are only available to clients when they wish to conduct a Quality Audit of the company.

As a final stage of this project the writer conferred with the staff of Mace Engineering in small groups to discuss the implications of the Quality Assurance System.

## Chapter five. Discussion

The scope of this thesis had two distinct parts. Firstly, the writer acquainted himself with the concept of Quality Assurance Systems and their implementation and uses. Once this had been achieved the writer addressed the problem as to how such a system could be applied to a local Jobbing Factory.

It became apparent when working in the factory and being exposed to other Companies in the engineering field, that there were two different concepts of Quality Assurance and what it was used for. One group, composed of the majority of companies, were of the opinion that Q.A. was "something you had to have so that contracts were awarded to you" and implementation of such a system was unnecessary until market forces dictated it. The other companies, that realised the potential and benefits of a Q.A. System, were in the minority.

Mace Engineering wished to introduce a Q.A. System primarily because several large contracts were looming that required prospective sub-contractors to have an existing and audited Quality Assurance System. Within the company, Q.A. was looked upon as a tool rather than a system to ensure quality. It was something that the company had to have but they were not going to let it interfere with what was going on already. This attitude contradicted the main philosophy behind the introduction of such systems.

The introduction of the two tier system was a logical step from the company's initial concept of Q.A. "Why go to the expense and time etc when a system could be devised to give Q.A. only for those customers that wanted it." Again, it was clear that basic reasons for the introduction of such systems were being ignored. Once the initial constraints were defined the writer had to design a system around them, then the necessary procedures were constructed as detailed in Chapter Four. At the end of this period a "Pre-Audit" check of the system was carried out by the Quality Assurance Division of Lloyds of London to determine what features of the system would need to be addressed in order to enable the company to achieve accreditation to ISO 9002-1987.

There were two main areas of fault indicated in the Pre Audit check.

1. That a two tier system in one workshop was not feasible because interaction led to the possible contamination of one tier by the other.
2. That the documentation produced for the system was not comprehensive enough to describe adequately the system and fell short of the requirements of the standard.

The writer investigated possible reasons for the shortcomings in the development of this Q.A. System and found the following areas to be contributing factors.

1. Overall Industry awareness on the use and benefits of Q.A. Systems lacks consistency and definition. At present

the general consensus on the use of these management systems is that they should be put off until contractual commitments require it. It is interesting to note that a large number of companies have registered their intent for accreditation to a Quality Assurance Standard within the last year. This writer suggests that this increase in the number of companies seeking accreditation is due to the effect of market forces and not through any company deciding the quality of their product should be addressed.

As this proliferation of Q.A. Systems occurs education on the use and benefits should be addressed. This is due to the fact that companies are starting to find they have to implement a system in order to stay competitive. It is as if, in effect, the companies are being forced into accepting this change. If more education were undertaken to show that the introduction of Q.A. Systems is essential because it is a way to reduce costs, improve productivity and quality, companies would accept change rather than be forced into it. Attitudes must change; until they do Quality Assurance will still remain a tool that is applied to a job rather than a system by which to work.

2. A second contributing factor is the lack of information as to the interpretation and implementation of the Standard itself and what is acceptable to the auditor. If Q.A. Systems are to be more acceptable for introduction in industry not only should their aims and benefits be made clear but more supporting (Government funded) organisations

and literature should be available for guidance. In addition to this the writer recommends the creation of a 'Watch-dog' committee to monitor organisations that perform Quality Audits in New Zealand. At present there are only two organisations offering accreditation to national and international standards. Both organisations are offering the same service but the situation is fast arriving where a contractor may start specifying the organisation that is to audit a producers Quality System. The type and scope of Quality Systems and their implementation should be clarified before widespread introduction. Furthermore, a specification detailing audit procedures should be addressed to ensure standardisation between organisations performing audits.

## Chapter Five. Conclusions and Recommendations

It is clear from this investigation that there are two difficulties with Quality Assurance Systems that must be addressed before benefits from the use of such systems can be widespread. The actual implementation of a Q.A. System poses no difficulty but the reason behind the decision to implement the system is based upon attitudes which are difficult to change. In many cases it will be possible to change these attitudes by education of the workforce. The second difficulty that must be addressed relates to the auditing of such systems for accreditation. A control body should be set up to ensure a constant standard in auditing throughout the country and subsequent compatibility with overseas auditors. This would ensure an auditing body is not chosen on the basis that it is more liberal in interpreting the standard.

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5. New Zealand Standard 5600 Pt 2 1987. Section 0.4.5.
6. ISO 9002:1987. Page 3

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**Appendix A**

**Mace Engineering Limited Quality Assurance Manual.**

MACE ENGINEERING LIMITED

QUALITY ASSURANCE MANUAL

Mace Engineering Ltd.	Quality Assurance Manual.	Page: i
Title: Company Policy		Revision:0

Company Policy.

The company wants to improve it's reputation as a precision machine shop capable of manufacturing parts and components for New Zealand and overseas Companies and to supply these products to an acceptable and consistent quality level.

Results from the implementation of this quality drive should improve Mace Engineering's ability to attract a wider range of work, decrease manufacturing costs through less wastage, provide staff with greater job satisfaction and security, as well as improving the financial profitability of the company for shareholders.

The Quality Assurance Policy and Plan is issued to define all aspects that effect the quality of the firms products and will be the basis of all future manufacturing procedures.

Quality Policy.

The company has adopted a policy of only supplying to the customer those parts, components and assemblies which meet their satisfaction, have the desired level of Quality Assurance and function efficiently throughout their designed lifetime.

The company aims to compete in the marketplace by supplying quality products which lead in design and manufacturing techniques and are available at an economic price.

Declaration of Principles.

To reach these objectives, the quality levels of each product and the associated Quality Control procedures will be fully specified and a plan drawn up to achieve this objective at the minimum possible cost.

The quality level will firstly be determined by the specification and quality levels of our customers. For products of our own design the Quality Level will be determined by the quality level of similar products made by world leading companies.

The company will be dedicated to the "right first time" principle, where each employee shall endeavour to produce no defective work and where the required quality level will be controlled at the point of manufacture rather than at final inspection.

Each department and group will be responsible for correcting deviations from specified quality levels originating in their respective working area.

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Mace Engineering Ltd.	Quality Assurance Manual.	Page: ii
Title: Company Policy		Revision:0

The quality of our product, plant and services is determined by:

- Our Client's wishes and requirements.
- The defined application.
- State of the art.
- Legal regulations.
- Rules for the prevention of accidents.
- Standards and Codes.

This Quality Assurance Manual and any supplementary volumes of detailed procedures and specifications describe all the necessary measures required for planning, production and maintaining and improving quality.

Our Quality Assurance Manual for Mace Engineering is intended to demonstrate to our Clients that we meet all conditions required to ensure the high level of quality they expect.

Authorised by:

Date issued: 1/9/90

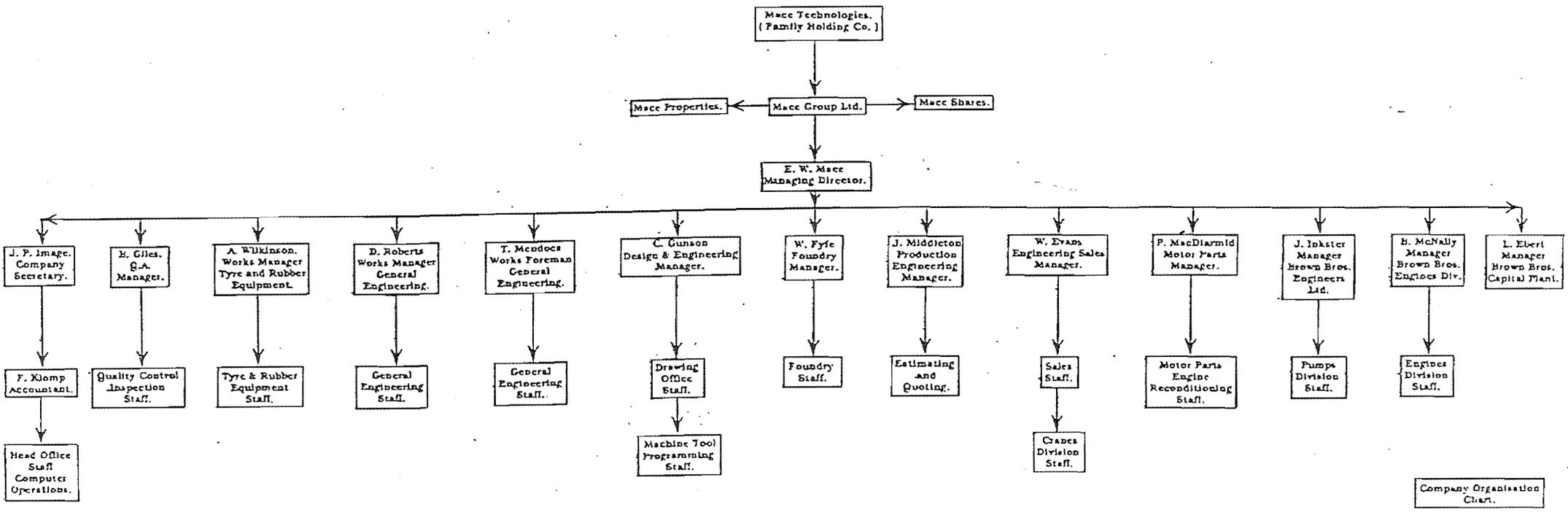


Mace Engineering Ltd.	Quality Assurance Manual.	Page: iv
Title: Table of Contents		Revision:0

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<u>Page No.</u>	<u>Section.</u>
i.	Company Policy
iii.	List of Revisions
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2/1.	2.0 Quality Assurance Management.
	2.1 Responsibilities of the Q.A. Manager.
2/2.	2.2 Responsibilities of all Company Managers.
3/1.	3.0 Quality Assurance Review & Audit
4/1.	4.0 Quality Assurance Manual Control.
5/1.	5.0 Quality Costs.
6/1.	6.0 Documentation & Change Control.
7/1.	7.0 Supplier Quality Control.
	7.1 Assessment & approval of suppliers.
	7.2 Supplier non-conformance.
	7.3 Supplier listing.
8/1.	8.0 Purchasing Control.
	8.1 Description.
	8.2 Additional information on procedures.
9/1.	9.0 Inwards Goods Inspection & Storage.
	9.1 Description of procedures.
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	9.3 Additional information on procedures.
10/1.	10.0 Manufacturing Control.
	10.1 Description.
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	10.3 Manufacture of goods.
10/2.	10.4 Control of non-conforming material.
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	11.1 In process inspection & testing.
11/2.	11.2 Final inspection testing.
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	12.3 Calibration of test equipment.
12/2.	12.4 Test hardware.
13/1.	13.0 Handling, Storage Packaging & Delivery.

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14/1	14.0 Employee Training	
<u>List of Figures.</u>		
<u>Page No.</u>	<u>Title.</u>	
1/2	Company Organisation Chart	
8/3	Fig.1 Purchasing Control Procedures	
9/3	Fig.2 Inwards Goods Procedures	
10/3	Fig.3 Manufacturing Control Procedures	
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Mace Engineering Ltd.	Quality Assurance Manual.	Page: 1/1
Title: 1.0 Quality System		Revision:0
<p><u>1.0 Quality System.</u></p> <p>This section describes the Quality System presently employed by Mace Engineering Ltd. It consists of a description of the system, Company Organisation Chart and Management Responsibilities of Quality Assurance (Q.A.) personnel.</p> <p>The Q.A. System employed at Mace Engineering Ltd is to be accredited to the International Standard ISO 9002. This Manual describes the procedures and specifications required and how they have been implemented by this company to achieve the standard.</p> <p>Mace Engineering Ltd employs a two tiered Q.A. System for the benefit of it's customers. Prospective customers indicate the degree of Q.A. that is to be incorporated into the manufacture of their product. There are two options.</p> <p>Option one is a system that fully guarantees any goods produced adhere to the quality specifications outlined in the Standard ISO 9002. That is, Mace Engineering Ltd assures the customer that all documentation, purchasing control, manufacturing control, inspection and testing are in accordance with this standard.</p> <p>Option two is for those customers who have determined their finished product does not warrant the inclusion of these more comprehensive Q.A. procedures and associated documentation of Quality. In this instance the extent of documentation, production procedures etc. required can be discussed with Mace Engineering Ltd and an agreement reached.</p> <p>A flowchart depicting the Company's system for planning and manufacturing a product can be found on page 10/3.</p> <p>The Q.A. Manager has direct responsibility to the Managing Director. See Company Structure (Page 1/2).</p> <p>The Q.A. Manager, working in conjunction with the Design Engineer, Works Managers and Customers ensures that direct action can be taken to ensure Quality is foremost in all products manufactured. Thus, with the approval of the Managing Director the Q.A. Manager has the responsibility and means to coordinate and revise all aspects of the Q.A. Programme.</p>		
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Mace Engineering Ltd.	Quality Assurance Manual.	Page: 2/1
Title: 2.0 Quality Assurance Management		Revision:0
<p><u>2.0 Quality Assurance Management.</u></p> <p><u>2.1 Responsibilities of the Q.A. Manager</u></p> <p>2.1 Controlling and amending the Company's Q.A. Manual.</p> <p>2.2 Coordination and revision of the Company's Q.A. Programme.</p> <p>2.3 Advising and reporting to the Managing Director on all aspects of the Q.A. Programme.</p> <p>2.4 Initiating and monitoring actions on identified Quality problems.</p> <p>2.5 Authorisation and implementation of all procedures, inspections, tests, incoming goods and purchases, manufactured items and despatched goods. This will be done in accordance with the relevant procedures outlined in this manual.</p> <p>2.6 Material sourcing approval.</p> <p>2.7 Implementation and interpretation of defect failure analysis, Quality Cost measurement and other quality control operations.</p> <p>2.8 Coordination of Quality Audits within the Company to appraise the function of the Q.A. Programme and assess the level of Quality provided by the Company.</p> <p>2.9 Maintaining the Company's calibration system for gauge and test equipment to an acceptable standard.</p> <p>2.10 Assessment of production machinery and it's capability to produce work to the required tolerances and specifications.</p> <p>2.11 Destruction or disposal of all defective items that cannot be economically repaired.</p> <p>2.12 Monitoring customer feedback (complaints, servicing costs (etc.) and ensuring that this information is relayed to all relevant departments to improve future products.</p> <p>2.13 Keeping the Company's reputation for Quality foremost by ensuring concessions are not made that would result in unacceptable quality.</p> <p>2.14 Ensuring that the Companys Quality Level continually improves.</p>		
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Mace Engineering Ltd.	Quality Assurance Manual.	Page: 2/2
Title: 2.0 Quality Assurance Management		Revision:0
<p><u>2.0 Quality Assurance Management.</u></p> <p><u>2.2 Responsibilities of all Company Managers.</u></p> <p>2.1 Ensuring that this Quality Manual is available to all members of their functional group.</p> <p>2.2 Ensuring that all persons within their functional group understand the function of and their role in this Quality Assurance Programme.</p> <p>2.3 Motivating personnel to adhere to the principles of this Q.A. programme.</p> <p>2.4 Encouraging and taking note of feedback from employees, suppliers and customers.</p> <p>2.5 Ensuring no concessions are made that would adversely affect the company policy.</p> <p>2.6 Economically maintaining the objectives of this Quality Policy.</p> <p>2.7 Continually improving the Quality level in their functional group.</p>		
Authorised by:		Date issued: 1/9/90

Mace Engineering Ltd.	Quality Assurance Manual.	Page: 3/1
Title: 3.0 Quality Assurance Review & Audit		Revision:0
<p><u>3.0 Quality Assurance Review and Audit.</u></p> <p>3.1 At periodic intervals (of not more than twelve (12) months) the Q.A. Manager will implement an "in house" Audit and Review of the Quality Assurance Programme.</p> <p>3.2 The Q.A. Manager will prepare a questionnaire to assess the operation and effectiveness of the Quality Assurance Programme. This Questionnaire will be structured to give an indication of the following areas.</p> <p>3.20 Questions structured so that the Company's adherence to the certified standard may be assessed.</p> <p>3.21 Questions to assess employee understanding of the Quality Assurance System.</p> <p>3.22 Questions to show up any inconsistencies in the system and suggested improvements to be made.</p> <p>3.3 The Q.A. Manager will use the information gained from this audit to assess the efficiency of the current Q.A. system to the benefit of the company and customers.</p> <p>3.4 Suggested questions and format for this audit may be found in the Procedure Manual.</p>		
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Mace Engineering Ltd.	Quality Assurance Manual.	Page: 4/1
Title: 4.0 Quality Assurance Manual Control		Revision:0
<p data-bbox="111 336 829 369"><u>4.0 Quality Assurance Manual Control.</u></p> <p data-bbox="111 403 1340 504">4.1 The Q.A. Manager will keep a master copy of this manual to which all copies can be referred to for verification of alterations.</p> <p data-bbox="111 526 1412 660">4.2 Only the Q.A. Manager may make alterations, additions or subtractions to this manual. These changes must be recorded in the table of revisions along with a date and signature and any pertinent comments.</p> <p data-bbox="111 683 1412 817">4.3 The Q.A. Manager is responsible for ensuring all "in house" copies of the manual have the correct revisions. The Q.A. Manager will; at his discretion, notify manual holders outside the company of any revisions.</p> <p data-bbox="111 840 1412 907">4.4 The Q.A. Manager will keep a record of the distribution of all manuals.</p>		
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Mace Engineering Ltd.	Quality Assurance Manual.	Page: 5/1
Title: 5.0 Quality Costs		Revision:0
<p><u>5.0 Quality Costs.</u></p> <p>5.1 The Q.A. Manager, in conjunction with the Company Accountant will be responsible for implementing and maintaining a system to categorise Quality Costs for the company.</p> <p>5.2 Quality cost categories will be recorded as follows:</p> <ul style="list-style-type: none"><li>5.20 In factory failure costs.</li><li>5.21 Ex factory failure costs.</li><li>5.22 Appraisal costs.</li><li>5.23 Prevention costs.</li></ul> <p>5.3 A further breakdown of these costs may be found in the Procedures Manual.</p>		
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Mace Engineering Ltd.	Quality Assurance Manual.	Page: 6/1
Title: 6.0 Documentation and Change Control		Revision:0

6.0 Documentation and Change Control.

- 6.1 The Q.A. Manager will keep a master list of all documents and their revision numbers.
- 6.2 All documents will have a code and revision number on the top right hand corner of the document to identify them.
- 6.3 The Q.A. Manager will ensure that all departments of the company have the appropriate documentation needed for the effective functioning of the quality system.
- 6.4 The Q.A. Manager is responsible for the recovery and destruction of all obsolete documents.
- 6.5 Mace Engineering Ltd. will, in agreement with the customer decide on a time limit for the retention of records. The default time period for retention of all records will be Five (5) years.
- 6.6 Upon completion of a contract all documents pertaining to that contract will be collected and stored in a place specified by the Q.A. Manager.
- 6.7 Only the Q.A. Manager has the authority to alter a document. All employees have a responsibility to notify the Q.A. Manager of any errors in documentation.

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Mace Engineering Ltd.	Quality Assurance Manual.	Page: 7/1
Title: 7.0 Supplier Quality Control		Revision:0
<p data-bbox="92 342 660 378"><u>7.0 Supplier Quality Control.</u></p> <p data-bbox="92 409 906 445">7.1 Assessment and Approval of Suppliers.</p> <p data-bbox="188 472 1295 539">7.10 Mace Engineering Ltd. will assess prospective suppliers. Suppliers must satisfy the following criteria:</p> <ul style="list-style-type: none"> <li data-bbox="292 566 1398 633">(1) Able to meet material compliances to National and/or International standards.</li> <li data-bbox="292 660 1161 728">(2) Able to provide certificates of material compliance.</li> <li data-bbox="292 754 1279 822">(3) Able to meet other standards specified by Mace Engineering Ltd. from time to time.</li> </ul> <p data-bbox="92 853 673 889">7.2 Supplier Non-Conformance.</p> <p data-bbox="188 916 1359 1041">Where the supplier cannot provide material conformance certificates Mace Engineering Ltd will either verify Quality at source or upon receipt of purchase that it conforms to the specified requirements.</p> <p data-bbox="92 1072 501 1108">7.3 Supplier Listing.</p> <p data-bbox="188 1135 1398 1328">The Q.A. Manager will compile a list of suitable suppliers for the Purchasing Officer to consult when ordering materials. Only suppliers which comply with the Company's standards will be selected to supply material. Suppliers in the list will be reassessed periodically to ensure they still meet Mace Engineering Quality criteria.</p> <p data-bbox="92 1355 347 1391">7.4 Suppliers</p> <p data-bbox="188 1417 1318 1512">Suppliers should contact Mace Engineering Ltd to determine what other standards may be required when tendering for contracts.</p>		
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## 8.0 Purchasing Control.

8.1 The Purchasing Control Procedures are described in flowchart form given in Figure 1 ( page 8/3 ). The flowchart depicts the actions of the company's staff from the initial point where a decision is made to purchase goods or materials through to the point where an order for material is despatched by the Company.

Samples of the documentation to be used are given in the Procedures Manual.

### 8.10 Overview.

To distinguish between those purchases that need more comprehensive documentation and those where it is unnecessary the company operates a purchasing system which distinguishes between the orders.

Purchasing control is accomplished using a two tiered system. The client, in agreement with Mace Engineering Ltd. will select which purchasing control procedures to use. When certification of material and an assurance of quality is needed the Works Manager completes a more comprehensive Purchase Requisition Form and purchases are then completed by the Purchasing Officer in conjunction with the Q.A. Department.

When Clients do not require full documentation the ordering is performed by the Works Managers using a standard order book.

For urgent orders the Works Manager and the Client may agree to waive these procedures. Written authorisation must be sought from the Client and the exact procedure fully documented.

Material sourced from the Client must comply with these procedures or an alternative agreement reached and recorded in writing.

Mace Engineering Ltd.	Quality Assurance Manual.	Page: 8/2
Title: 8.0 Purchasing Control		Revision:0
<p>8.2 Additional Information For Purchasing Control Procedures.</p> <p>8.20 Purchase Requisition Form.</p> <p>The Works Manager will clearly describe all requirements and conditions pertaining to the material to be ordered. These will be set out on the Purchase Requisition form ( See Procedures Manual ). Where necessary he will consult the Q.A. department, the Design Officer and the Client to ensure all details of the material listing are correct.</p> <p><u>8.0 Purchasing Control (cont.)</u></p> <p>8.21 Purchase Order Form.</p> <p>The Purchasing Officer, Upon completion of the Purchase Order shall send one copy to the Q.A. Department and one copy to the Works Manager concerned. The Purchase Order Form will include a due date for delivery</p>		
Authorised by:		Date issued: 1/9/90

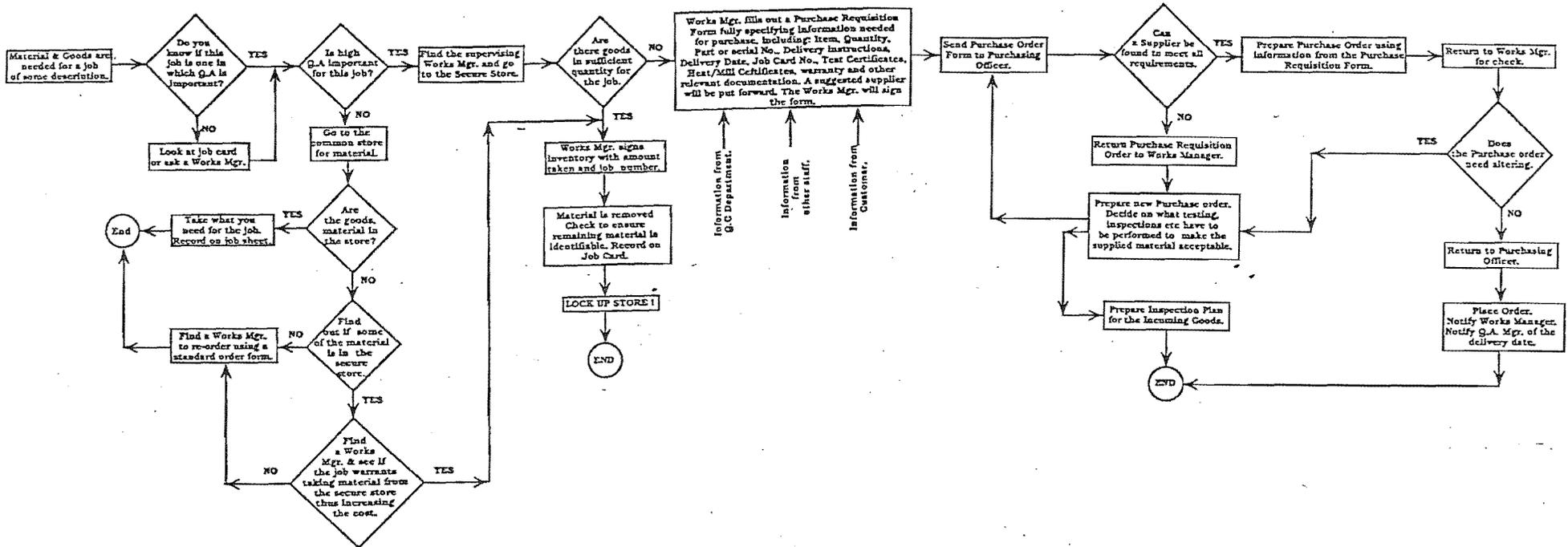


Figure one: Flowchart Depicting Ordering Of Goods.

Mace Engineering Ltd.	Quality Assurance Manual.	Page: 9/1
Title: 9.0 Inwards Goods Inspection and Storage		Revision:0
<p><u>9.0 Inwards Goods Inspection, Testing and Storage.</u></p> <p>9.1 Description of procedures for Mace Engineering Ltd.'s Inwards Goods, Inspection and Storage Procedures are given by a flowchart in Figure 2, Page 9/3.</p> <p>9.2 Overview of Procedures.</p> <p>9.20 For ease of delivery and customer convenience all purchases ordered on the standard order form may be delivered to any one of the company's reception points and from there transferred to the common store or to the worksite.</p> <p>Those materials ordered by the Purchasing Officer are delivered to the Inwards Goods Inspection Bay situated on Wilmer Street. This is specified on the order form. This material is then subject to inwards goods inspection. In the event of a non arrival of an order on a given date the Q.A. Manager is to be notified and remaining reception areas checked for the arrival of an order. If the order is located it is then transferred to the inwards goods inspection bay and inspected. If the order is not located the supplier is then contacted.</p> <p>After arrival and inspection all material is then transferred to the Secure store.</p> <p>9.3 Additional Information On Procedures.</p> <p>9.30 The Inwards Inspection Procedures are set out in Figure Two. Material may not be used until it has passed this inspection and the appropriate documentation completed. If the material is not needed immediately it will be transferred to the secure store.</p> <p>9.31 In the event of an order being needed urgently the Q.A. Manager, after consultation with the customer may waive inspection procedures and release material to the workshop. This waiver must be fully documented and a written authorisation received from the customer before the material is released</p> <p>9.31 Should the Inwards goods inspection be delayed the material must be marked accordingly and transferred to the secure store to await inspection.</p> <p>9.33 Only the Q.A. Manager or his designated delegate are permitted to perform the incoming inspection.</p> <p>9.34 The secure store is to be kept locked at all times. A Works Manager must be present to unlock the store.</p>		
Authorised by:		Date issued: 1/9/90

Mace Engineering Ltd.	Quality Assurance Manual.	Page: 9/2
Title: 9.0 Inwards Goods Inspection and Storage		Revision:0
<p><u>Inwards Goods Inspection, Testing and Storage (cont.)</u></p> <p>9.35 All material residing in the store will be recorded in the inventory folder.</p> <p>9.36 Persons removing material from the store must ensure that any material remaining is adequately identified.</p> <p>9.37 The Q.A. Manager will assess the reason for any non-conforming material and dispose of it or return it to the supplier as necessary.</p>		
Authorised by:		Date issued: 1/9/90

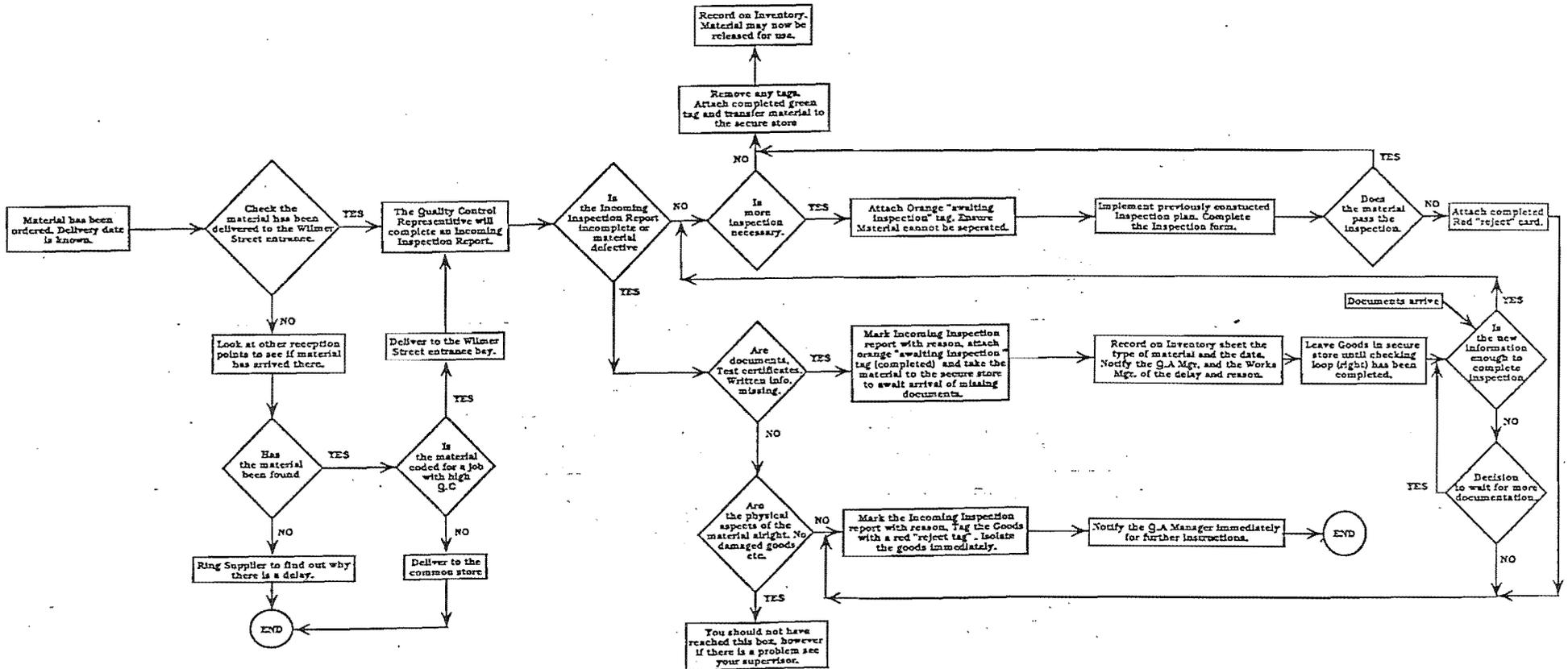


Figure Two: Lowards Goods Procedure

Mace Engineering Ltd.	Quality Assurance Manual.	Page: 10/1
Title: 10.0 Manufacturing Control		Revision:0
<p><u>10.0 Manufacturing Control.</u></p> <p>10.1 A description of the manufacturing control procedures is given in Figure 3. This flowchart depicts the procedures the staff of Mace Engineering Ltd. adhere to for the planning and production of a manufactured good. There are three distinctive areas to be considered.</p> <ul style="list-style-type: none"> <li>(1) Pre manufacture planning</li> <li>(2) Manufacture</li> <li>(3) Defect control and corrective action</li> </ul> <p>10.2 Overview.</p> <p>10.20 Planning.</p> <p>For the client who has indicated that Mace Engineering Ltd. is to provide a high degree of Q.A. the company conducts exhaustive pre-manufacturing planning.</p> <p>The Works Manager who has been assigned the order, in association with the Q.A. Manager and Quotation and Planning Officer, makes a decision on the order of operations, machinery requirements, production techniques and staff to be used to complete the order. The machinery requirements are selected through the demonstrated capability of the machines on past and present jobs. The outcome of this planning is the Job Instruction Sheet.</p> <p>The Job Instruction sheet lists all the Client information and gives a step by step plan for the production of an item. Several job instruction sheets may be needed for an order.</p> <p>At this stage an Inspection Plan is also formulated. The plan is referenced to the Job Instruction Sheet so that at critical points of manufacture the specified inspection may take place. Production cannot proceed past these points without an authorised inspection having taken place.</p> <p>10.3 Manufacture of goods.</p> <p>10.30 Manufacture of goods cannot commence without a Job instruction sheet, Inspection Plan and Drawing.</p>		
Authorised by:		Date issued: 1/9/90

10.0 Manufacturing Control (cont.).

10.31 All goods must be manufactured as per the instructions specified on the Job Instruction Plan.

10.32 Manufacture will not proceed past an inspection point without the relevant inspection having taken place.

10.33 Any proposed alterations to the Job Instruction Sheet must have the written approval of the Works Manager concerned.

10.34 Any proposed alterations to the Inspection plan must have the approval of the Q.A. Manager.

10.35 Only the Q.A. Manager or his representative are permitted to perform inspections.

10.4 Control of Non-Conforming Material.

10.41 Overview

Detection of a non-conformity in a product during it's manufacture will result in the immediate isolation of the product to the appropriate section of the secure store, visual marking with the use of a tag and completion of a Non-Conforming Material Report. (See Procedures Manual)

The Non-Conforming Material Report will indicate possible courses of action available - Rework, repair or scrap - as well as why the non-conformance has come about.

The Works Manager will decide upon the course of action to be taken with the non-conforming material. If rework or repair is to be attempted then a Rework/Repair Authorisation Sheet must be completed and returned to the Client for approval before work may continue.

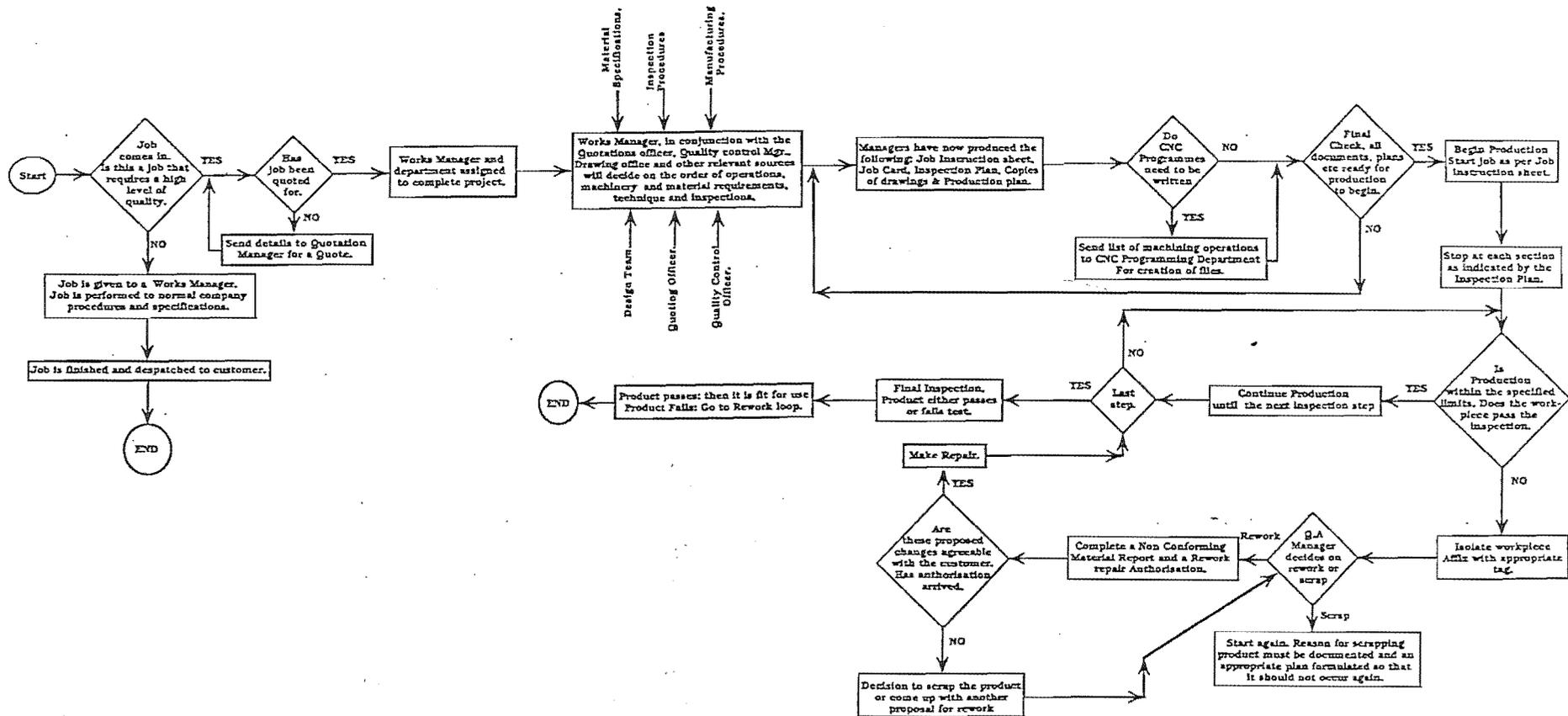


Figure Three : Production System.

Mace Engineering Ltd.	Quality Assurance Manual.	Page: 11/1
Title: 11.0 Inspection and Testing		Revision:0
<p><u>11.0 Inspection and Testing.</u></p> <p>11.1 In Process Inspection and Testing.</p> <p>In process inspection and testing will follow the procedure laid out in the Inspection Plan that was formulated before manufacture began. It is the responsibility of the Works Manager to ensure that production of an item does not proceed past an inspection point without the appropriate inspection having taken place.</p> <p>In the event of an inspection not being able to be performed the workpiece shall be affixed with a "Hold Awaiting Inspection" tag. The tag must be completed with the following particulars:</p> <ol style="list-style-type: none"> <li>(1) Department</li> <li>(2) Date</li> <li>(3) Inspection Report Number</li> <li>(4) Job Card Number</li> <li>(5) Signature of Inspector</li> </ol> <p>The workpiece must then be removed to the appropriate area of the secure store to await inspection. In the event of the workpiece being required immediately it may be released without inspection only with the written authority of the Q.A. Manager.</p> <p>The workpiece must be positively identified and the inspection plan duly endorsed by the Q.A. Manager to indicate the procedure that has taken place.</p> <p>If a workpiece fails inspection it shall immediately be affixed with a red "reject" tag and isolated in the appropriate area of the secure store until it is disposed of by the Q.A. Manager. A non-conforming material report will be completed.</p> <p>11.2 Final Inspection and Testing.</p> <p>11.20 Final inspection will not occur until all specified Incoming and In-process Inspection and Tests have taken place and the data meets the required specifications.</p> <p>11.21 Final inspection will be carried out in accordance with the Inspection Plan.</p>		
Authorised by:		Date issued: 1/9/90

11.0 Inspection and Testing (cont.).

11.22 Upon passing final inspection the Q.A. Department will issue an Inspection release certifying that the product has conformed to specified requirements.

11.23 Delivery of the finished product will not commence until all activities specified in the quality plan have been satisfactorily completed.

Mace Engineering Ltd.	Quality Assurance Manual.	Page: 12/1
Title: 12.0 Inspection Measuring and Test Equipment		Revision:0
<p data-bbox="113 331 1002 365"><u>12.0 Inspection, Measuring and Test Equipment.</u></p> <p data-bbox="113 398 903 432">12.1 The Quality Control Inspection Room.</p> <p data-bbox="209 461 1414 618">12.10 This room is the designated area for the testing and calibration of instruments. Where practical, all tests on material and workpieces will take place here also. When inspections and tests are made outside of this room conditions are to be standardised as far as possible.</p> <p data-bbox="209 651 1337 775">12.11 The test room temperature will be held at a constant twenty degrees Celsius. Any equipment, workpieces etc will be left to acclimatise to this temperature prior to testing.</p> <p data-bbox="209 808 1337 875">12.12 Only authorised people are allowed accessto the test room and the doors will be kept shut at all times.</p> <p data-bbox="113 936 595 969">12.2 Test Room Equipment.</p> <p data-bbox="209 999 1394 1122">12.20 All new test room equipment and boxes shall be suitably marked with a "Mace" number and relevant characteristics recorded into a Mace Engineering Inspection Sheet.</p> <p data-bbox="209 1155 1356 1312">12.21 The Quality Assurance Manager shall ensure that the equipment held in the Test Room shall be sufficient for the calibration of equipment and the inspection of critical dimensions, tolerances and hardness characteristics of finished products.</p> <p data-bbox="209 1346 1398 1447">12.22 The Q.C. Officer shall arrange certified firms to perform those specialised testing procedures not available at Mace Engineering Ltd.</p> <p data-bbox="113 1507 791 1541">12.3 Calibration of Test Equipment.</p> <p data-bbox="209 1570 1359 1693">12.30 Test equipment will be calibrated in one of two ways. Equipment in frequent and general use will be calibrated at regular intervals. Infrequently used equipment will be calibrated at the discretion of the Q.A. Manager</p>		
Authorised by:		Date issued: 1/9/90

12.0 Inspection, Measuring and Test Equipment (cont.).

12.31 Blue or Red squares will be hung at visible sites throughout the factory. The colour of the square will alternate every six (6) months. Only those measuring instruments marked with the same colour as these squares are permitted to be used. Under no circumstances is an instrument marked with a different colour to be used.

12.32 Every six months there will be a period of one week where two differently coloured squares will be visible. This period is when all equipment is recalibrated. Equipment with either colour marking may be used during this time. After this period all equipment will be recalibrated and only the new coloured square will be visible.

12.33 If an instrument is dropped or damaged or if there is reason to suspect the accuracy of a instrument it should be taken to the test room for recalibration.

12.34 Each instrument will have it's own inspection sheet. When an instrument is checked for accuracy the inspection sheet must be stamped "checked" and the date and inspectors signature recorded. Comments may be added at this time.

12.35 Infrequently used test instruments will be recalibrated at the discretion of the Q.C. Officer but this will be dependant upon:

- (1) Time since last used
- (2) Time since last inspection

12.36 Every two (2) years the calibration system shall be reviewed and a decision made to increase/decrease the period between calibration checks.

#### 1.40 Test Hardware.

Jigs, templates, patterns and fixtures shall be subject to the same inspection procedure as those instruments referred to in section 12.35.

Mace Engineering Ltd.	Quality Assurance Manual.	Page: 13/1
Title: 13.0 Handling Storage ackaging and Delivery		Revision:0
<p><u>13.0 Handling, Storage, packaging and Delivery.</u></p> <p>13.0 The works manager shall specify such handling, storage, packaging and delivery procedues such that they prevent damage or deterioration of the finished product until supplier responsibility ceases.</p>		
Authorised by:	Date issued: 1/9/90	

#### 14.0 Employee Training.

Mace Engineering Ltd's employees training needs are to be identified and suitable training courses are to be identified and implemented to meet these needs.

#### 14.1 Identification of training needs.

Each Works Manager will be responsible for periodically reviewing the training requirements of the staff in his department. The Works Manager will assess the following points when reviewing training needs.

- (1) The type of work performed
- (2) Changes in Job description or responsibility
- (3) Present Employee qualifications and training

#### 14.2 Methods of Training.

Once the Training requirements have been identified by the Works Manager they may be fulfilled by any or all of the following methods:

- (1) On the job training
- (2) External courses
- (3) Temporary transferral to another department

14.3 All Employee Record Sheets are to be updated regularly to show current levels of qualifications and training.

Mace Engineering Ltd.	Quality Assurance Manual.	Page: 17/1
Title: 17.0 Sample Documentation		Révision:1
<p><u>Sample Documentation.</u></p> <p>The following pages provide sample copies of the Documentation that Mace Engineering employs in the running of it's Quality Assurance System. A list of all the documentation is given below.</p> <ol style="list-style-type: none"><li>1. Documentation Listing.</li><li>2. Job Card</li><li>3. Job Instruction Sheet.</li><li>4. Purchase Requisition Form.</li><li>5. Purchase Order Form.</li><li>6. Incoming Inspection Report.</li><li>7. Nonconforming Material Report.</li><li>8. Rework/repair Record.</li><li>9. Inspection Plan.</li><li>10. Inspection Release.</li><li>11. Inspection Tags.</li></ol>		
Authorised by:		Date issued: 1/4/90



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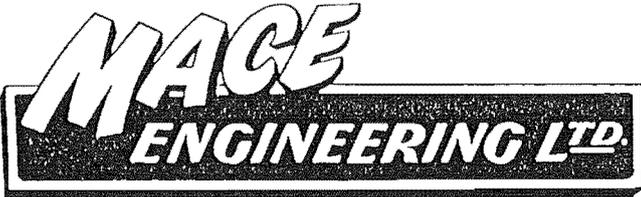
CHRISTCHURCH, New Zealand

CODE NO. \_\_\_\_\_

REV. NO. \_\_\_\_\_

HEAD OFFICE:  
183 DURHAM STREET  
Christchurch  
New Zealand  
Telephone (03) 795-750  
Facsimile (03) 63528  
Telex NZ 4564

CUSTOMER	
JOB NO:	DATE:
DOCUMENTATION	REFERENCE NOS.
JOB CARD NO.	
JOB INSTRUCTION SHEET	
DRAWINGS (NOS. & REVISIONS)	
PURCHASE REQUISITION FORM	
PURCHASE ORDER FORM	
HEAT TREATMENT CERTIFICATES	
MILL CERTIFICATES	
INCOMING INSPECTION REPORT	
NONCONFORMING MATERIAL REPORT	
REWORK/REPAIR RECORD	
INSPECTION PLAN	
OTHER:	



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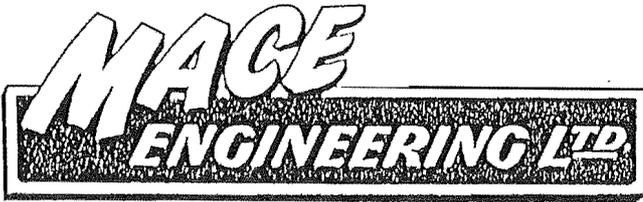
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Christchurch  
New Zealand  
Telephone (03) 795-750  
Facsimile (03) 63528

PAGE \_\_\_\_\_ OF \_\_\_\_\_

JOB INSTRUCTION PLAN

JOB NUMBER		SIGN AND DATE TASKS AS COMPLETED
DATE		
CUSTOMER		
DRAWING NO. & REV.		
DEPARTMENT		
ISSUED BY		
TASK	MACHINE	



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Christchurch  
New Zealand  
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Facsimile (03) 63528  
Telex NZ 4564

PURCHASE REQUISITION FORM

JOB CARD NO.

DRAWING NO.

REVISION NO.

ITEM AND/OR PART/SERIAL NUMBER

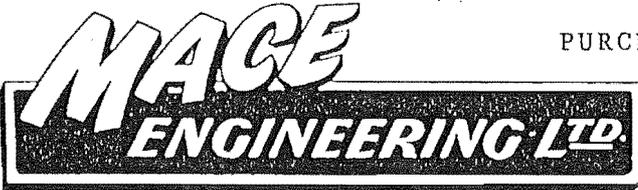
QUANTITY

TEST CERTIFICATES REQUIRED (INCLUDES HEAT/MILL CERTIFICATES)

OTHER RELEVANT DOCUMENTS TO BE SUPPLIED

SUGGESTED SUPPLIER

DELIVERY INSTRUCTIONS AND DUE DELIVERY DATE



PURCHASE ORDER

Code No: 00000000

Rev No: 000

HEAD OFFICE:  
183 DURHAM STREET  
Christchurch  
New Zealand  
Telephone (03) 795-750  
Facsimile (03) 63528  
Telex NZ 4564

P.O. BOX 4049

CHRISTCHURCH, New Zealand

Job No: 00000

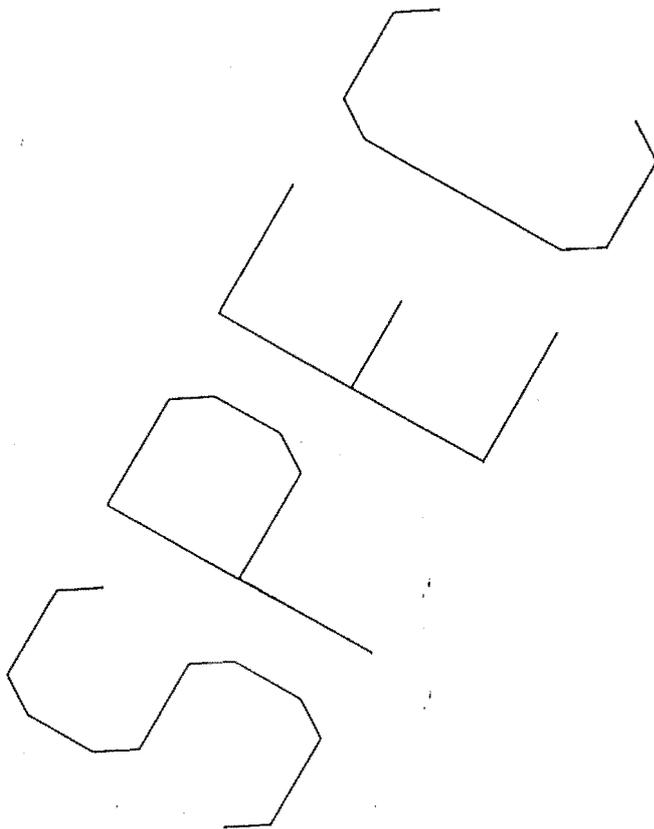
Dwg No: 0000000

Purchase Order No: 000000

Date: 00/00/00

Conditions of Purchase/

1. Basis of order is F.I.S/Ex Warehouse/Ex Railhead
2. Method of transport is Air Freight/Road Transport/Courier/Post
3. Terms of payment are:.....
4. The Following Test certificates are required with this order.  
Heat cert. ... Mill cert. ... Other .....
5. Your promised delivery date is .....
6. Please supply the following;

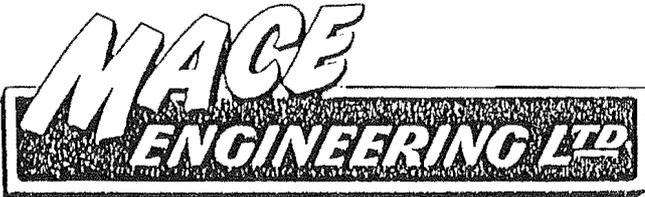


\*\*\*Please deliver all goods to DOOR 4 Wilmer St. Christchurch\*\*\*

PLEASE ACKNOWLEDGE  
THIS ORDER AND CONFIRM  
DELIVERY DATE AND PRICE

Order authorised by: B.W.THOMAS

Name/Title:



P.O. BOX 4049

CHRISTCHURCH, New Zealand

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REV. NO. \_\_\_\_\_

HEAD OFFICE:  
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Christchurch  
New Zealand  
Telephone (03) 795-750  
Facsimile (03) 63528  
Telex NZ 4564

INCOMING INSPECTION REPORT

DATE RECEIVED: \_\_\_\_\_

JOB NO. \_\_\_\_\_

ORDER NO. \_\_\_\_\_

CUSTOMER \_\_\_\_\_

SUPPLIER \_\_\_\_\_

DESCRIPTION OF GOODS:

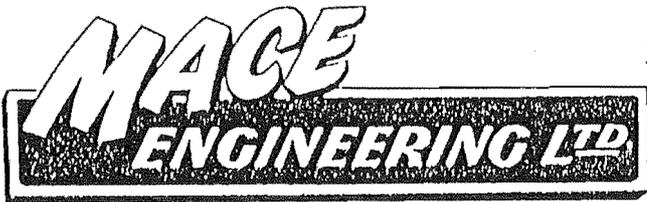
GOODS WERE: DELIVERED/PICKED UP  
PACKING SLIP ENCLOSED YES/NO  
IDENTIFYING SERIAL/PART NUMBERS

ALL TEST CERTIFICATES/WARRANTIES/DOCUMENTATION AS PER PURCHASE ORDER?  
RECORD DOCUMENTS BELOW ALONG WITH ANY ADDITIONAL IDENTIFICATION.

QUANTITY OF GOODS AS PER PURCHASE ORDER YES/NO  
GOODS IN ACCEPTABLE CONDITION YES/NO  
FURTHER INSPECTION NECESSARY YES/NO  
IF YES, AFFIX "HOLD AWAITING INSPECTION TAG".  
IF GOODS NOT ACCEPTABLE, AFFIX "REJECT" TAG.  
IF GOODS ARE ACCEPTABLE, AFFIX "USE" TAG.  
ALL GOODS TO BE KEPT IN SECURE STORE.

INSPECTED BY:

DATE:



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New Zealand  
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Facsimile (03) 63528  
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NON CONFORMING MATERIAL REPORT

DEPARTMENT		CUSTOMER	
DATE	JOB NO.	PART NO.	
SUPPLIER:		DRG NOS. REV	
DESCRIPTION OF MATERIAL/PART			
DESCRIPTION OF NONCONFORMITIES			
REASON FOR NONCONFORMITIES			
IS CORRECTIVE ACTION POSSIBLE?			YES/NO
IF YES, WHAT CORRECTIVE ACTION IS SUGGESTED:			
(1) MATERIAL/PART HAS RED "REJECT" TAG ATTACHED			YES/NO
(2) MATERIAL/PART HAS BEEN ISOLATED			YES/NO
IF EITHER (1) OR (2) IS NO THEN THIS MUST BE DONE IMMEDIATELY.			

INSPECTED BY:

DATE:



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New Zealand  
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Facsimile (03) 63528  
Telex NZ 4564

REWORK/REPAIR AUTHORISATION

DEPARTMENT: \_\_\_\_\_

CUSTOMER: \_\_\_\_\_

JOB NO: \_\_\_\_\_

DRG NO. & REV: \_\_\_\_\_

PART NO: \_\_\_\_\_

DESCRIPTION OF NONCONFORMITY: \_\_\_\_\_

DATE: \_\_\_\_\_

PROPOSED ACTION

USE AS IS

REPAIR

MODIFY

SECTION FOR CUSTOMER TO COMPLETE

MACE ENGINEERING LIMITED PROPOSE THE ABOVE ACTIONS TO RECTIFY A NONCONFORMITY. IS THIS ACCEPTABLE? YES/NO

REMARKS

AUTHORISATION:

DATE:

CUSTOMER APPROVAL

YES/NO

IF YES, CARRY OUT MODIFICATIONS TO NONCONFORMING MATERIAL/PART  
IF NO, PART/MATERIAL IS TO BE SCRAPPED AND WORKS MANAGER NOTIFIED.

AUTHORISED:

DATE:



CODE NO. \_\_\_\_\_

REV. NO. \_\_\_\_\_

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Christchurch  
New Zealand  
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Facsimile (03) 63528

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CHRISTCHURCH, New Zealand

PAGE OF \_\_\_\_\_

JOB INSPECTION PLAN

JOB NO.		INSPECTION COMPLETED
DATE		
CUSTOMER		
DRG NO. & REV		
DEPARTMENT		
ISSUED BY		
NO. OFF	NO. INSPECTED	SIGN AND DATE
TASK	DESCRIPTION OF INSPECTION AND MEASURING EQUIPMENT REQUIRED	DATE

TASK NUMBER FROM JOB INSTRUCTION PLAN

STOP



P.O. BOX 4049

CHRISTCHURCH, New Zealand

CODE NO. \_\_\_\_\_

REV. NO. \_\_\_\_\_

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Christchurch  
New Zealand  
Telephone (03) 795-750  
Facsimile (03) 63528  
Telex NZ 4564

CIRCULATION LIST

CUSTOMER: \_\_\_\_\_

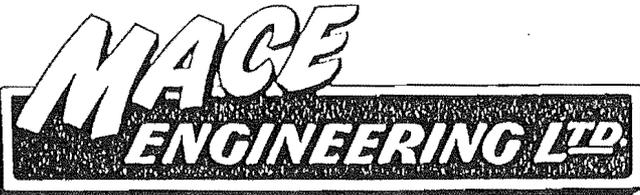
DATE: \_\_\_\_\_

JOB NO: \_\_\_\_\_

DRG NO. \_\_\_\_\_

ISSUED TO	DEPARTMENT	DRG. NO.	REV. NO.	DRAWING RECOVERED	DATE





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CODE NO. \_\_\_\_\_

REV NO. \_\_\_\_\_

HEAD OFFICE:  
183 DURHAM STREET  
Christchurch  
New Zealand  
Telephone (03) 795-750  
Facsimile (03) 663-528

QUALITY ASSURANCE DEPARTMENT  
INSPECTION RELEASE

DATE	
JOB NUMBER	
CUSTOMER	
ORDER NUMBER	
DRAWING SUPPLIED BY	
DRAWING NUMBER	
JOB DESCRIPTION	
SPECIAL INSTRUCTIONS	
MATERIAL	
MATERIAL SPECIFICATIONS	
NUMBER OFF	
NUMBER CHECKED IN BATCH	
HEAT TREATMENT	

TOLERANCED DIMENSIONS WITHIN LIMITS

YES

NO

NA

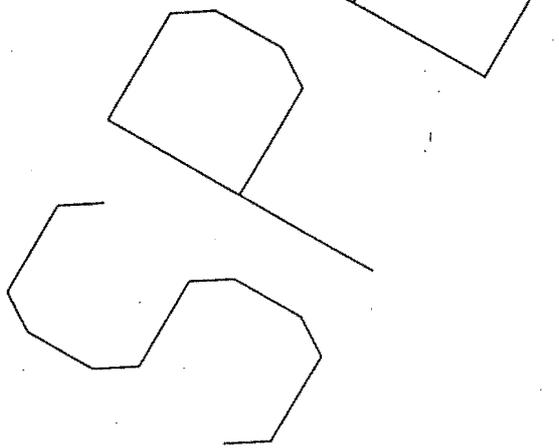
UNTOLERANCED DIMENSIONS WITHIN LIMITS

YES

NO

NA

COMMENTS:



RELEASED BY \_\_\_\_\_

DEPT. \_\_\_\_\_

DATE REJECTED \_\_\_\_\_

INSPECTION \_\_\_\_\_

REPORT NO. \_\_\_\_\_

JOB NO. \_\_\_\_\_

SIGNATURE \_\_\_\_\_



DEPT. \_\_\_\_\_

DATE \_\_\_\_\_

INSPECTION \_\_\_\_\_

REPORT NO. \_\_\_\_\_

JOB NO. \_\_\_\_\_

SIGNATURE \_\_\_\_\_



DEPT. \_\_\_\_\_

DATE \_\_\_\_\_

INSPECTION \_\_\_\_\_

REPORT NO. \_\_\_\_\_

JOB NO. \_\_\_\_\_

SIGNATURE \_\_\_\_\_



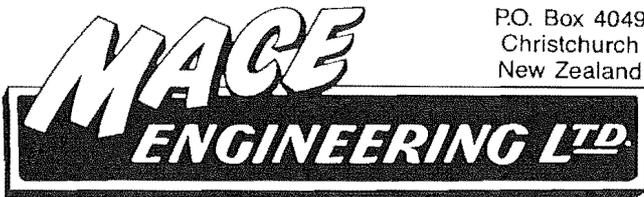
**REJECT** ○

**HOLD** AWAITING  
INSPECTION ○

**USE** THIS  
MATERIAL ○  
ONLY

Appendix B

Mace Engineering Limited Procedures Manual.



P.O. Box 4049  
Christchurch  
New Zealand

**GROUP HEAD OFFICE:**  
183 Durham Street  
P.O. Box 4049  
Christchurch  
**Telephone (03) 795-750**  
**Facsimile 64 3 663-528**

A Mace Group Company

PAGE: 1 of 6

PROCEDURE NO. P001  
REVISION NO. 0  
ISSUED: 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: JOB INSTRUCTION PLAN PREPARATION

### INTRODUCTION

This procedure deals with the design and preparation of the Job Instruction Plan. Preparation of the Job Instruction Plan is important as this document contains the job instructions, machinery requirements and inspection points necessary for the production of high quality goods.

### CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: JOB INSTRUCTION PLAN PREPARATION

PROCEDURE NO: P001

REVISION NO: 0

ISSUED: 1.9.90

### 1.0 SCOPE

This procedure applies to the preparation and implementation of all Job Instruction Plans in use at Mace Engineering Limited.

### 2.0 OBJECTIVES

This procedure describes the information to be contained in the Job Instruction Plan and in what form it is to be presented.

### 3.0 IMPLEMENTATION

This procedure is to be implemented as required.

### 4.0 RELEVANT PROCEDURES

This procedure can be cross-referenced to the following references.

Ref: P002 Procedure for: Job Inspection Plan Preparation  
Ref: P004 Procedure for: Quality Assurance Manual Control  
Ref: P006 Procedure for: Job Instruction Implementation

### 5.0 PROCEDURE RESPONSIBILITIES

It is the responsibility of the Works Manager in charge of the job to complete the appropriate Job Instruction Plan.

### 6.0 METHOD

The Works Manager, upon receiving a job will complete the Job Sheet pertaining to that job. There are two types of Job Sheet, the Non-Q.A. Job Sheet and the Q.A. Job Sheet. The Q.A. Job Sheet is coloured pink.

PROCEDURE NO. P001  
REVISION NO. 0  
ISSUED: 1.9.90

#### 6.10 THE JOB SHEET FOR NON Q.A. JOBS

The Works Manager will detail the workshop instructions in the space provided on the Job Sheet. However, if enough space is not available on the Job Sheet, the Works manager will use a Job Instruction Plan as well. The Job Number, Date, Customer, Drawing Numbers, Rev., and the Department sections are to be completed.

#### 6.11 WORKSHOP INSTRUCTIONS

In all but the simplest of jobs, detailed work instructions shall be recorded. These instructions will list step by step the different operations that will entail completion of the job to an acceptable quality level. Each of these steps will list:

- (a) The task number.
- (b) The machine or workstation where each operation will take place.
- (c) A detailed description of the task to be performed. This includes any critical dimensions, tolerances, special instructions, tooling, etc.
- (d) Any sketches deemed necessary by the Works Manager. The Works Manager shall be aware that workshop personnel can be of assistance in preparing this plan in view of their experience.

A line is to be drawn across the sheet after each task has been detailed. The instructions should be clear and concise. Any ambiguities should be avoided. Where inspections are to be performed the Q.C. Department should be consulted and a description of the inspection detailed on the Job Instruction Plan. Comprehensive inspections shall be detailed on the Job Inspection Plan.

#### 6.12 FEEDBACK FROM THE SHOP FLOOR

Where the person assigned to a task indicates there is not enough information detailed for a task or that possible improvements can be made, this information will be added to the Job Instruction sheet by the Works Manager.

PROCEDURE NO. P001  
REVISION NO. 0  
ISSUED: 1.9.90

### 6.13 STORAGE OF JOB INSTRUCTION PLANS

Where there is every possibility of a repeat job, the Job Instruction Plan will be filed in the Q.A. Manager's office along with all other pertinent information - Inspection Releases, Incoming Inspection Reports, Drawings, etc.

## 6.2 THE JOB SHEET FOR Q.A. JOBS

### 6.21 WORKSHOP INSTRUCTIONS

In the case of jobs requiring a high degree of quality, it is likely that they will be quite comprehensive. In this instance the Works Manager in charge of the job is expected to liaise with:

- (a) The Design Engineer
- (b) The Quoting Officer
- (c) The Q.A. Manager
- (d) The Customer
- (e) The Machine Operators

when the Job Instruction Plan is being constructed. The Job Instruction Plan will detail every step of the production of the item. Each step (or task) will indicate the machine or area where the task is performed and give sufficient information to enable the task to be performed. Information should include:

- (a) tooling
- (b) setup
- (c) material
- (d) drawing
- (e) special instructions

Each task should be separated from the next by a ruled line. Where the product is to be inspected between operations, this should be indicated and referenced to an accompanying Job Inspection Plan which will have more detail.

### 6.22 FEEDBACK FROM THE SHOP FLOOR

See Section 6.12

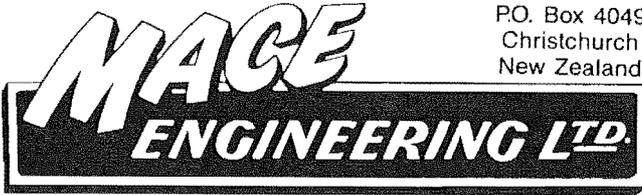
PROCEDURE NO. P001  
REVISION NO. 0  
ISSUED: 1.9.90

7.0 PROCEDURE CHECK

The Works Manager shall verify that the Job Instruction Plan contains the necessary information to enable the product to be manufactured to its desired degree of quality before production begins.

8.0 DOCUMENT PATHS

One copy of the Job Instruction Plan shall be retained by the Works manager, one copy distributed to the shop floor and the master copy is to reside in the job file retained by the Q.A. Manager.



P.O. Box 4049  
Christchurch  
New Zealand

**GROUP HEAD OFFICE:**  
183 Durham Street  
P.O. Box 4049  
Christchurch  
**Telephone (03) 795-750**  
Facsimile 64 3 663-528

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PROCEDURE NO: P002  
REVISION NO: 0  
ISSUED: 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: JOB INSPECTION PLAN PREPARATION AND IMPLEMENTATION

## INTRODUCTION

This procedure details the preparation of Inspection Procedures and their implementation in the production system. It deals with both in-process and final inspection and thus is of major importance in the Quality System.

## CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: JOB INSPECTION PLAN PREPARATION AND IMPLEMENTATION  
PROCEDURE NO: P002  
REVISION NO: 0  
ISSUED: 1.9.90

### 1.0 SCOPE

This procedure applies to the in-process and final inspections of work produced by Mace Engineering Limited.

### 2.0 OBJECTIVES

The objective of this procedure is to explain the creation of the Job Inspection Plan and how it is to be implemented in the Quality System.

### 3.0 IMPLEMENTATION

This procedure is implemented when constructing an inspection programme for a job.

### 4.0 RELEVANT PROCEDURES

Ref: P001 Job Instruction Plan Preparation  
Ref: P013 Calibration Procedures  
Ref: P005 Handling Packaging and Dispatch Procedures  
Ref: P003 Non Conforming Material Procedure

### 5.0 PROCEDURE RESPONSIBILITIES

It is the responsibility of the Q.A. Manager or an appointed delegate to prepare the Job Inspection Plan.

It is the responsibility of the Q.A. Manager or an appointed delegate to inspect the products of Mace Engineering Limited or to arrange inspection by an outside certified body if Mace Engineering Limited does not possess the appropriate inspection equipment.

It is the responsibility of the Q.A. Manager to liase with the Works Managers to enable interaction of production and inspection to proceed smoothly.

PROCEDURE FOR: JOB INSPECTION PLAN PREPARATION AND IMPLEMENTATION  
PROCEDURE NO: P002  
REVISION NO: 0  
ISSUED: 1.9.90

## 6.0 METHOD

### 6.1 Creation of Job Inspection Plan

#### 6.11 Job Inspection Sheets for Non Q.A. Jobs

The Q.A. Manager or a delegate will discuss with the Works Manager in charge of a job where in-process inspection points will take place in the manufacture of a product to ensure quality.

Once these areas have been determined the Inspection Process can be detailed for each point. These inspections can be detailed on the Job Instruction Plan if space permits but are more easily accomplished on the Job Inspection Plan.

The Plan first has the necessary information recorded.

- (1) Job No.
- (2) Date
- (3) Customer
- (4) Drawing No. and Revision
- (5) Department

For each inspection step the following information will be provided by the Q.C. department.

- (1) A description of the inspection to be performed. This will include:
  - (a) dimensions/tolerances
  - (b) method of inspection
  - (c) tooling or measuring equipment required
- (2) Who is to perform the inspection
- (3) Any special conditions the inspection must be performed under.

PROCEDURE FOR: JOB INSPECTION PLAN PREPARATION AND IMPLEMENTATION  
PROCEDURE NO: P002  
REVISION NO: 0  
ISSUED: 1.9.90

#### 6.12 JOB INSPECTION PLAN FOR Q.A. JOBS

The Inspection Plans are created at the same time as the Job Instruction Plans (Ref P001). Thus the Q.A. Manager will discuss the types of inspection and at what stages of production it will occur. Discussions are held with:

- (a) The Design Engineer
- (b) The Quotations Officer
- (c) The Works Manager
- (d) The Customer
- (e) Machine Operators

to ascertain the type and frequency of inspections so that quality in the product may be assured. These inspections will then be recorded on the Job Inspection Plan as detailed in Section 6.11.

Where Mace Engineering Limited cannot perform the necessary inspections provision will be made for a certified body to perform the inspections. This will be detailed on the Job Inspection Plan.

### 6.2 INSPECTION PROCEDURE

The Q.A. Manager or delegate will be contacted by the Works Manager or machine operator when the production process halts at an inspection point. The inspection will then be performed as detailed in the inspection plan.

#### 6.21 In-process Inspection

For these inspections the workpiece will be inspected as per the plan, passing the inspection releases it to the next stage in the production process. If it fails Procedure P003, Procedure for Non-conforming Material is to be implemented. As each inspection is completed it must be dated and signed in the right hand column by the inspector.

#### 6.22 Final Inspection

Again, the product is inspected as per the Job Inspection Plan. If the product passes the inspection a Inspection Release Form is completed and the item is released for packing and dispatch (Procedure P005). If the product fails the final inspection, Procedure P003 for non conforming material is to be implemented.

PROCEDURE FOR: JOB INSPECTION PLAN PREPARATION AND IMPLEMENTATION  
PROCEDURE NO: P002  
REVISION NO: 0  
ISSUED: 1.9.90

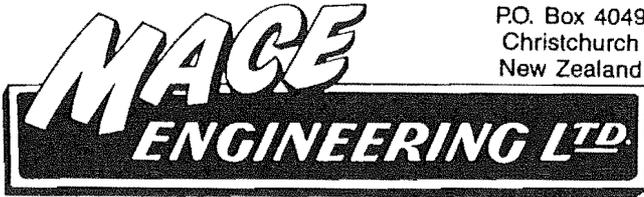
#### 7.0 PROCEDURE CHECK

Each inspection is verified by the inspector signing and dating the Job Inspection Plan upon completion of the inspection.

The final inspection is verified by signing and dating the Job Inspection Plan and the Inspection Release.

#### 8.0 RECORDS

One copy of the Job Inspection Plan is to be kept on the shop floor with the Job Instruction Plan, one copy is kept by the Inspector, and the original copy is to be kept in the Job Master File.



P.O. Box 4049  
Christchurch  
New Zealand

**GROUP HEAD OFFICE:**  
183 Durham Street  
P.O. Box 4049  
Christchurch  
**Telephone (03) 795-750**  
**Facsimile 64 3 663-528**

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PROCEDURE NO. P003  
REVISION NO. 0  
ISSUED: 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: NON CONFORMING MATERIAL

## INTRODUCTION

This procedure describes the work performed, persons responsible and action to be taken when non conforming material is located during production of goods. The non conforming material is located by in process and final inspections as well as employee vigilance.

## CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: NON CONFORMING MATERIAL  
PROCEDURE NO: P003  
REVISION NO: 0  
ISSUED: 1.9.90

PAGE 2 OF 5

### 1.0 SCOPE

This procedure applies to (1). All in process material that is found to be defective and (2) all material that differs from specifications upon final inspection. (This does not include specifications altered with customer approval.)

### 2.0 OBJECTIVES

This procedure describes the action to be taken when a product is found to differ from specifications. Thus the objective is to ensure that no defective products leave Mace Engineering Limited and if non conforming material occurs during production it is adequately controlled to ensure the quality of the final product is not affected.

### 3.0 IMPLEMENTATION

This procedure is to be consulted when material or a product is found to differ from specification either during production or upon final inspection.

### 4.0 RELEVANT PROCEDURES

- (1) Ref P001 Job Instruction Plan
- (2) Ref P002 Inspection PLAN preparation and implementation
- (3) Ref P012 Quality Cost Determination

PROCEDURE FOR: NON CONFORMING MATERIAL  
PROCEDURE NO: P003  
REVISION NO: 0  
ISSUED: 1.9.90

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## 5.0 PROCEDURE RESPONSIBILITIES

Upon identification of non conforming material by inspection or employee vigilance, it is the responsibility of:

- (1) The Q.A. Manager and Works Manager to decide if the material is to be scrapped, reworked or repaired.
- (2) The Q.A. Manager or his delegate to complete the Non Conforming Material Report.
- (3) The Works manager to complete and dispatch the Rework/Repair Authorisation to the client.
- (4) The Works Manager, upon receipt of customer approved Rework/Repair Authorisation to re-issue the Job Instruction and Inspection Plans with the appropriate alterations.
- (5) The Q.A. Manager to document the (possible) cause of this non conforming material.
- (6) The Q.A. Manager to document the costs involved with the non conformity.

## 6.0 METHOD

This procedure begins from the point where inspection procedures or employee vigilance has resulted in the identification of non conforming material. This material was then tagged and isolated and the Q.A. Manager notified. The Q.A. and Works Managers will then decide whether the material in question is to be reworked, repaired or scrapped.

### 6.10 Material is to be scrapped.

The Q.A. Manager will ensure that the material is destroyed or marked in such a way that it cannot be used.

The reason for scrapping the material will be identified and documented in a Non Conforming Material Report (Example Pg 5). If investigations show that there is the possibility of this event reoccurring, an appropriate plan must be formulated to avoid or minimise this non conformity.

The Works Manager will authorise the re-commencement of work for the order to replace the defective material.

The Q.A. Manager will identify all costs involved as laid out in procedure P012, Quality Cost Determination Procedure.

PROCEDURE FOR: NON CONFORMING MATERIAL  
PROCEDURE NO: P003  
REVISION NO: 0  
ISSUED: 1.9.90

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#### 6.20 Material is to be Reworked or Repaired

The Works Manager will complete a Non Conforming Material Report and if the investigations show that there is a possibility of this event reoccurring an appropriate plan must be formulated to avoid or minimise this non conformity.

This plan will then be implemented.

The Q.A. and Works Managers will then propose a suitable plan for the rework or repair of the article - work to be done, new inspections etc. The Works Manager will then complete a Rework/Repair Authorisation detailing what is to be done to correct the non conformity. this Authorisation will be sent to the client for their approval. If this is agreeable, the repair plan will be implemented.

Should the customer not be agreeable to the rework/repair plan then the Works Manager has two options (1) propose a new plan or (2) scrap the material as detailed in 6.10.

#### 7.0 PROCEDURE CHECK

The Q.A. Manager will ascertain that if the material has not been scrapped then rework or repair of the material does not commence without the following actions being performed.

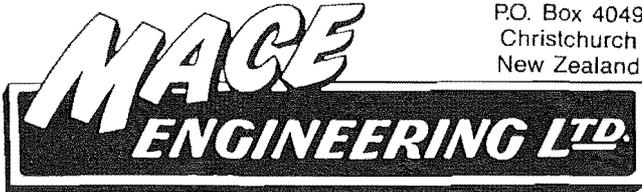
- (1) A completed Non Conforming Material Report
- (2) A revised Job Instruction Plan from the Works Manager
- (3) Authorisation from the customer.

#### 8.0 DOCUMENT PATHS

One copy of the Non Conforming Material Report is to be retained by the Works Manager and the original copy is to be forwarded to the Q.A. Manager to be kept in the Job Master File.

A copy of the Rework/Repair record is to be kept by the Works Manager and the original is to be kept in the Master File when returned by the customer.

Any revised copies of the job Instruction Plan and Job Inspection Plans are to be kept by the Works Manager and copies are to be kept by the Q.A. Manager in the Master File.



P.O. Box 4049  
Christchurch  
New Zealand

GROUP HEAD OFFICE:  
183 Durham Street  
P.O. Box 4049  
Christchurch  
Telephone (03) 795-750  
Facsimile 64 3 663-528

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PROCEDURE NO: P004  
REVISION NO: 0  
ISSUED: 1.9.90

PREPARED BY: A SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: QUALITY ASSURANCE MANUAL CONTROL

## INTRODUCTION

Quality Manual Control is necessary to ensure that controlled copies of the Manual are efficiently and accurately revised and obsolete documents are removed. It is also necessary to establish locations for the manual for effective function of the Quality System.

## CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: QUALITY ASSURANCE MANUAL CONTROL  
PROCEDURE NO: P004  
REVISION NO: 0  
ISSUED: 1.9.90

### 1.0 SCOPE

This procedure applies to Mace Engineering Limited's Quality Assurance and Procedures Manual.

### 2.0 OBJECTIVES

This procedure describes how control of the Quality Assurance and Procedures Manuals are achieved and what steps need to be taken for subsequent document changes and alterations.

### 3.0 IMPLEMENTATION

This procedure is implemented (1) upon receipt of a request for a modification/change to the Manual and (2) a request for a controlled/uncontrolled copy of the manual.

### 4.0 RELEVANT PROCEDURES

REF: All procedures  
REF: Quality Assurance Manual

### 5.0 PROCEDURE RESPONSIBILITIES

It is the responsibility of the Quality Assurance Manager for the preparation issue and amendment of the Quality Assurance and Procedure Manuals. At the Q.A. Manager's discretion he may delegate some functions to appropriate staff members.

Each holder of a Q.A. or Procedure Manual is responsible for

- (1) the insertion of new or amended sections in the manual
- (11) destroying any superseded material

The Quality Assurance manager shall maintain the master copy of the Q.A. and Procedure manuals as well as their distribution lists.

### 6.0 METHOD

The Quality Assurance Manager will retain a master copy of the Q.A. and Procedure Manuals to identify the current revision of the documents.

PROCEDURE FOR: QUALITY ASSURANCE MANUAL CONTROL  
PROCEDURE NO: P004  
REVISION NO: 0

6.1 Procedure for Issue of Q.A. and Procedure Manuals

6.11 In house distribution of Q.A. and Procedure Manuals

The Q.A. Manager will distribute Q.A. and Procedure manuals to Works Managers. All Manuals and Procedures are designated as controlled. Each Manual shall be checked against the Master Copy to ensure that it is the correct revision. After distribution the Works Managers shall ensure that the Manuals area available to all staff in their functional group.

6.12 Ex house distribution of Q.A. and Procedure Manuals

All Manuals distributed to approved clients of Mace Engineering Limited are designated either controlled or uncontrolled. All controlled Manual holders will be issued with amended documents as they are completed. Uncontrolled Manuals will not be updated. Each Manual will be marked controlled or uncontrolled.

6.13

Upon issue of a Q.A. or Procedure Manual the Q.A. Manager will update the Q.A. and Procedures Manual Register. This register will include revisions, date issued, to whom it was issued and their company. Uncontrolled copies may be issued without recording particulars but users must be made aware of their validity.

6.2 Procedure for reviewing Q.A. and Procedure Manuals

6.21 Annual Review

The Q.A. and Procedure Manuals' content shall be reviewed annually by the Q.A. Manager or a suitable delegate. Changes to documentation may result from this review.

6.22 Proposed Changes

Any employee may propose changes to either the Q.A. or Procedures Manuals. These proposals will be brought to the attention of the Q.A. Manager. The Q.A. Manager will review the proposals and the employee will be informed of the Q.A. Manager's decision regarding the proposals.

PROCEDURE FOR: QUALITY ASSURANCE MANUAL CONTROL  
PROCEDURE NO: P004  
REVISION NO: 0

### 6.3 Procedure for Document changes/modifications

Once a modification to a document has been made and the master copy altered the Q.A. Manager will distribute the new document to all holders of controlled copies of the manual. The Q.A. Manager may re-issue documents after a practical number of changes have been made. Accompanying the documents will be a "Notice of Change" form which will be completed giving details of superseded documents to the Controlled Manual holder.

Upon receipt of the modified documents and Notice of Change form the controlled copy holder will insert the new documents in their controlled copy, destroy the superseded documents and advise the Q.A. Manager to this effect.

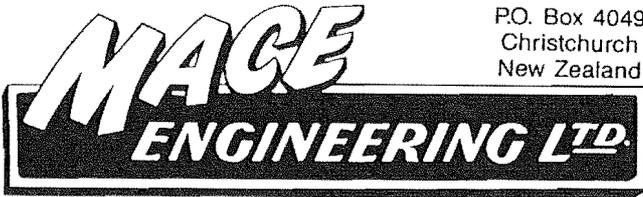
Upon receipt of confirmation that the controlled manuals have been updated the Q.A. Manager will note the status of the revision in the Q.A. Manual Register.

### 7.0 PROCEDURE CHECK

The Q.A. Manager shall verify that all the controlled Q.A. and Procedure Manuals contain the current revision of each document.

### 8.0 DOCUMENT PATHS

A copy of every Notice of Change form is to be kept with the Q.A. Manual Register until the holder of the controlled Q.A. or Procedure Manual has acknowledged updating their Manual.



P.O. Box 4049  
Christchurch  
New Zealand

GROUP HEAD OFFICE:  
183 Durham Street  
P.O. Box 4049  
Christchurch  
Telephone (03) 795-750  
Facsimile 64 3 663-528

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PROCEDURE NO: P005  
REVISION NO: 0  
ISSUED: 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: HANDLING, PACKING AND DISPATCH OF GOODS

## INTRODUCTION

To ensure all manufactured items produced by Mace Engineering Limited reach our customers to their specifications it is necessary to employ Handling, Packing and Dispatch Procedures to minimise the risk of damage during production and transit.

## CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: HANDLING, PACKING AND DISPATCH OF GOODS  
PROCEDURE NO: P005  
REVISION NO: 0  
ISSUED: 1.9.90

### 1.0 SCOPE

These procedures apply to all items manufactured and assembled by Mace Engineering Limited for final dispatch to customer as well as covering those items dispatched to subcontractors during production.

### 2.0 OBJECTIVES

This document describes procedures for ensuring that manufactured items are correctly packed and delivered so the quality of the item is not diminished during transit.

### 3.0 IMPLEMENTATION

As needed: For dispatch of item to subcontractor  
For dispatch of completed job to customer

### 4.0 RELEVANT PROCEDURES

REF: P001 Job Instruction Plan Preparation  
REF: P002 Job Inspection Plan Preparation and Implementation

### 5.0 PROCEDURE RESPONSIBILITIES

It is the responsibility of the Works manager to specify the handling, packing and dispatch methods for each job.

### 6.0 METHOD

Packing and dispatch of items produced will occur under the following conditions.

6.1 The Job Instruction Plan indicates that this task is to be performed. Normally this will occur on those jobs which have been given a high quality rating. The Job Instruction Plan will specify the preferred type of packaging for the item including any special requirements for protective measures and mode of delivery. This will occur in two possible instances.

PROCEDURE FOR: HANDLING, PACKING AND DISPATCH OF GOODS  
PROCEDURE NO: P005  
REVISION NO: 0  
ISSUED: 1.9.90

- (1) In production - in this instance a partially completed product is packaged and sent to a sub-contractor. An inspection (as detailed on the Job Inspection Plan) must take place first.
- (2) After the completion of the final inspection. In this instance the Inspection Release must be completed and signed before packing is started.

6.2 In the absence of any detailed instructions regarding the packing and delivery of a product the Works Manager will specify how it is to be achieved.

When indicated on the Job Card or Job Instruction Sheet marking of the product will take place as specified. If there are no specific instructions the product is not to be marked or stamped in any way.

### 6.3 DELIVERY OF PRODUCT

Unless a specific mode of delivery is agreed upon between Mace Engineering and the client, the Works manager in charge of the job will specify the mode of delivery.

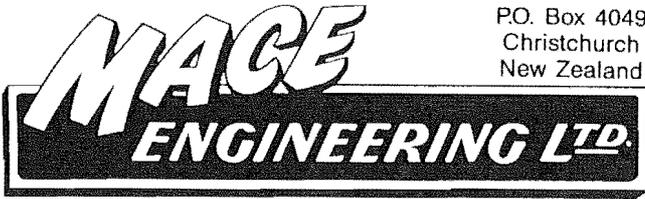
### 7.0 PROCEDURE CHECK

Verification of work ready for packaging is given by:

- (1) Completed, signed and dated Inspection Release
- (11) As specified in the Job Instruction Plan.

### 8.0 DOCUMENT PATHS

A copy of the delivery papers is to be retained by the Works Manager and the original is to be kept by the Q.A. Manager in the Job Master File.



P.O. Box 4049  
Christchurch  
New Zealand

**GROUP HEAD OFFICE:**  
183 Durham Street  
P.O. Box 4049  
Christchurch  
**Telephone (03) 795-750**  
Facsimile 64 3 663-528

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PROCEDURE NO: P006  
REVISION NO: 0  
ISSUED: 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: JOB INSTRUCTION IMPLEMENTATION

### INTRODUCTION

With Job Cards and Job Instruction/Inspection Plans being circulated within the workplace it is necessary to use and understand them fully to make them effective. This procedure details use of these documents.

### CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: JOB INSTRUCTION IMPLEMENTATION  
PROCEDURE NO: P006  
REVISION NO: 0  
ISSUED: 1.9.90

### 1.0 SCOPE

This procedure applies to the production of goods of varying Quality Assurance levels by Mace Engineering Limited staff. It applies to both Q.A. and non Q.A. jobs where Job Instruction Plans are used.

### 2.0 OBJECTIVES

This procedure sets out to explain the use of the Job Instruction Plan and how it should be interpreted for use in the manufacture of a product.

### 3.0 IMPLEMENTATION

This procedure is to be shown to every new employee of Mace Engineering Limited and is also to be consulted by those in doubt of how to use a Job Instruction Plan.

### 4.0 RELEVANT PROCEDURES

REF: P002 Job Inspection Plan Preparation and Implementation  
REF: P001 Job Instruction Plan Preparation

### 5.0 PROCEDURE RESPONSIBILITIES

It is the responsibility of the Works Manager in charge of the job to supply the employee with the relevant Job Card, Job Instruction Plan, CNC Job Sheet and drawings necessary to complete the job.

It is the responsibility of the employee assigned to the job to carry out the tasks indicated on the Job Instruction Plan and for signing and dating each section of the Job Instruction plan upon finishing the task.

PROCEDURE FOR: JOB INSTRUCTION IMPLEMENTATION  
PROCEDURE NO: P006  
REVISION NO: 0  
ISSUED: 1.9.90

## 6.0 METHOD

The completed Job Instruction Plan, Job Card, drawings and associated material are to be given to the employee before work on the job commences. (These will be contained in a clear plastic folder.) The Works Manager will detail the work to be performed and clarify any steps as needed.

Upon receiving the folder containing the documents the employee will check:

- (1) The Drawing No. and Revision No. are the same as on the drawing supplied.
- (11) The Job Instruction Plan for any ambiguities, omissions or mistakes.
- (111) The Job Instruction Plan, noting tasks to be performed, the order in which they occur and what inspections (if any) are to be performed.

After checking the documents the employee will ascertain that:

- (1) The correct machinery, tooling and resources exist to complete the assigned tasks.
- (11) The necessary training and skills have been acquired to perform the task.

As each task is completed, the employee will sign and date the Job Instruction Plan in the space provided. This must be done before the next task is started. Should an inspection point fall between two consecutive tasks on the same machine, work may not commence on the second task without the inspection and inspector's signature on the Job Instruction Plan.

An employee receiving a partially completed job will check that all tasks previously done have been signed and dated before work on the next task commences.

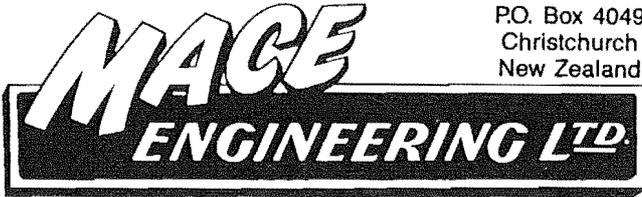
## 7.0 PROCEDURE CHECK

Verification of completion of a task is provided by the employee signing and dating the Job Instruction Sheet.

PROCEDURE FOR: JOB INSTRUCTION IMPLEMENTATION  
PROCEDURE NO: P006  
REVISION NO: 0  
ISSUED: 1.9.90

8.0 DOCUMENT PATH

The original copy of the Job Instruction Sheet will be kept by the Q.A. Manager in the master file. One copy will be circulated with the job and one copy retained by the Works Manager.



P.O. Box 4049  
Christchurch  
New Zealand

**GROUP HEAD OFFICE:**  
183 Durham Street  
P.O. Box 4049  
Christchurch  
**Telephone (03) 795-750**  
Facsimile 64 3 663-528

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PROCEDURE NO: P007  
REVISION NO: 0  
ISSUED: 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: SUPPLIER VETTING

## INTRODUCTION

An important aspect of the Quality System of Mace Engineering Limited is the purchase of materials for use in production. To ensure that only material of high quality is used in production, Mace Engineering Limited requires that their material suppliers demonstrate existence of a quality system. This document specifies the procedures that Mace Engineering Limited uses to select suppliers.

## CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: SUPPLIER VETTING  
PROCEDURE NO: P007  
REVISION NO: 0  
ISSUED: 1.9.90

### 1.0 SCOPE

This procedure details the selection of suppliers to furnish Mace Engineering Limited with the necessary material for those jobs with a high quality rating.

### 2.0 OBJECTIVES

This procedure stipulates the necessary steps and requirements associated with vetting a supplier so they meet the quality requirement of Mace Engineering Limited.

### 3.0 IMPLEMENTATION

This procedure is to be implemented when sourcing material for high quality level jobs.

### 4.0 RELEVANT PROCEDURES

REF: P008 Incoming goods procedure  
REF: P009 Purchase order form procedures

### 5.0 PROCEDURE RESPONSIBILITIES

It is the responsibility of the Q.A. Manager or a suitable delegate to vet suppliers of material in line with the instructions outlined in this procedure.

PROCEDURE FOR: SUPPLIER VETTING  
PROCEDURE NO: P007  
REVISION NO: 0  
ISSUED: 1.9.90

## 6.0 METHOD

### 6.1 Requirements of Supplier

The Q.A. Manager will receive a request for a vetted supplier to supply material for High Quality Jobs. If a suitable supplier has not already been approved by the Q.A. Manager the following procedure will apply.

The Q.A. Manager will initially select a supplier that demonstrates that their company maintains a satisfactory Q.A. System to ensure their product or service complies with the purchase specification. The products may also be required to be:

- (1) Able to meet material requirements to national or international standards.
- (2) Able to provide certificates of material compliance.
- (3) Able to meet other standards specified by Mace Engineering Limited.

### 6.2 Assessment of Supplier to meet requirements

The Q.A. Manager will ascertain that the supplier can meet the requirements of 6.1 by any or all of the following methods.

- (1) The company having a history of supplying high quality goods to Mace Engineering Limited.
- (2) The company having an approved Quality System to a recognised standard.
- (3) The company having been nominated as an acceptable supplier by the customer.
- (4) Having been judged acceptable by the Q.A. Manager on the basis of satisfactorily completing a Mace Engineering "Material Suppliers Audit" and/or an inspection of the premises by the Q.A. Manager.

PROCEDURE FOR: SUPPLIER VETTING  
PROCEDURE NO: P007  
REVISION NO: 0  
ISSUED: 1.9.90

### 6.3 Preferred Suppliers

Once a supplier has achieved approved status with Mace Engineering, their Company will be added to the "Preferred Supplier folder" and material may be sourced from them.

### 6.4 Annual Review

Annually the Q.A. Manager will review each supplier using the methods detailed in section 6.2. Suppliers who fail this review will lose their approved status. The Q.A. Manager may stipulate special conditions for the supplier to meet to enable them to continue supplying Mace Engineering.

### 6.5 Non Approved Suppliers

Where non approved suppliers have to be used for the sourcing of material, the Q.A. Manager will:

- (1) Conduct an Incoming Inspection such that the material is found to conform exactly to the requirements of the Purchase Order. The Incoming Inspection Report will detail these activities and inspections. Mace Engineering will provide the necessary inspection techniques and, if this is not possible, will contract out the inspection to a recognised testing authority.
- (2) Notify the customer as to the exact procedure of inspection and testing to see if this is acceptable.
- (3) Ensure the inspected material is clearly marked.

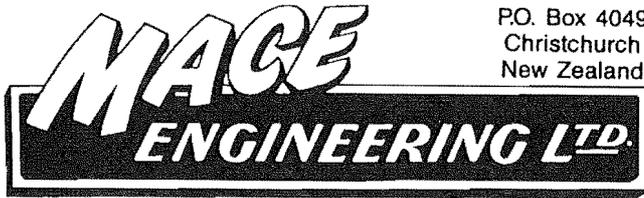
### 7.0 PROCEDURE CHECK

The Q.A. Manager will verify annually that (1) all approved suppliers meet the requirements of this procedure and that (2) new suppliers that Mace Engineering intend to source from meet these requirements.

PROCEDURE FOR: SUPPLIER VETTING  
PROCEDURE NO: P007  
REVISION NO: 0  
ISSUED: 1.9.90

8.0 DOCUMENT PATHS

The Q.A. Manager will keep a record of all approved suppliers. Where suppliers have returned Audit forms these will be kept by the Q.A. Manager as well.



P.O. Box 4049  
Christchurch  
New Zealand

GROUP HEAD OFFICE:  
183 Durham Street  
P.O. Box 4049  
Christchurch  
Telephone (03) 795-750  
Facsimile 64 3 663-528

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PROCEDURE NO: P008  
REVISION NO: 0  
ISSUED: 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: INCOMING GOODS

## INTRODUCTION

When goods and material are ordered it is necessary to determine, upon arrival, whether the description corresponds to the Purchase Order, the condition of the goods and whether the appropriate documentation is attached, before they are released to the workshop or store.

## CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: INCOMING GOODS  
PROCEDURE NO: P008  
REVISION NO: 0  
ISSUED: 1.9.90

### 1.0 SCOPE

This procedure applies to all incoming goods and material supplied to Mace Engineering Limited. This procedure also applies to items returned from subcontractors.

### 2.0 OBJECTIVES

This procedure sets out the actions to be taken upon delivery of goods and material to Mace Engineering Limited.

### 3.0 IMPLEMENTATION

This procedure is to be implemented upon delivery of goods or material to Mace Engineering Limited.

### 4.0 RELEVANT PROCEDURES

REF: P002 Inspection Sheet preparation and implementation  
REF: P007 Supplier Vetting  
REF: P009 Purchase Order Form

### 5.0 PROCEDURE RESPONSIBILITIES

It is the responsibility of the Q.A. Manager or delegate to complete an Incoming Inspection Report (and further inspection if necessary) for all goods delivered to door No. 4 in Wilmer Street.

It is the responsibility of the Works Manager ordering material to notify the Quantity Control Department of the delivery date of all goods requiring Inwards Inspection.

PROCEDURE FOR: INCOMING GOODS  
PROCEDURE NO: P008  
REVISION NO: 0  
ISSUED: 1.9.90

## 6.0 METHOD

Goods ordered fall into two categories.

- (1) Those goods ordered for contracts with a high quality level rating requiring full documentation of material quality level.
- (2) Those goods ordered which require less documentation and validity of their quality level.

Thus the Inwards Goods Procedure takes two routes depending upon the quality level of the goods that have been ordered.

### 6.1 Incoming goods procedure for Non Q.A. Jobs

Goods are delivered to any one of Mace Engineering Limited's reception points. They are then transferred either directly to the workplace where they are needed or directly to the store.

### 6.2 Incoming goods procedure for Q.A. Jobs

The delivery date of the goods is known from the Purchase Order (a copy of which is sent to the Q.A. Manager). Goods are delivered to Door No. 4 in Wilmer Street. (This is stipulated on the order form.) The Q.A. representative will check that the order has been delivered. If it has not the Q.A. representative will check other delivery points on the premises in case of delivery error. If this is the case the goods will be transferred to the Wilmer Street entrance. If the goods have not been located the Q.A. representative will contact the supplier.

Once the goods have been delivered an Incoming Inspection Report will be completed by the Q.A. representative. This involves comparison of the Purchase Order and documentation that accompanies the purchased material as well as a visual inspection for damage. The Q.A. representative will check to see if more inspection of the goods is necessary (detailed on the Job Inspection Plan) and if not a green inspection tag (marked "USE THIS MATERIAL ONLY") will be completed and attached to the material.

Should the Inspection Plan detail the need for more inspection the Q.A. representative will carry this out as per the plan. If the goods pass the inspection, a green inspection tag is attached. If the goods fail the inspection, a red "REJECT" tag is attached.

PROCEDURE FOR: INCOMING GOODS  
PROCEDURE NO: P008  
REVISION NO: 0  
ISSUED: 1.9.90

If the inspection cannot be performed immediately an orange "HOLD AWAITING INSPECTION" tag is completed and attached, the material is then locked in the secure store to await inspection.

If the Incoming Inspection Report indicates that documentation is missing or that the goods are damaged, the following procedures will be followed:

- 6.21 Should documentation be missing the goods will be attached with an orange "Hold Awaiting Inspection" tag and stored in the appropriate section of the secure store. The inventory sheet in the store will be updated. Upon arrival of the appropriate documents the Incoming Inspection Report is completed and a green "USE THIS MATERIAL ONLY" tag is attached. If no further documentation arrives a red "REJECT" tag is attached and the material scrapped.
- 6.22 If the goods are damaged they will be affixed with a red "REJECT" tag and isolated. A Non-Conforming Material Report will be completed and the supplier contacted about the non conformity.
- 6.23 The flow chart in figure 2 of the Q.A. Manual gives a clear pictorial view of these procedures.

#### 7.0 PROCEDURE CHECK

Verification of compliance to these procedures will be given by:

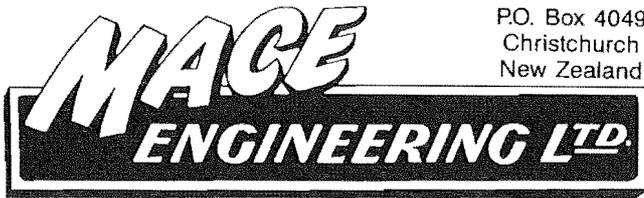
- (1) Completion of an Incoming Inspection Report
- (11) Completed inspection tags being attached to the inspected good.
  - (a) Green "Use This Material Only" tag.
  - (b) Orange "Hold, Awaiting Inspection" tag.
  - (c) Red "Reject" tag.
- (111) In the case of non conformity a Non-conforming Material Report will be completed.

PROCEDURE FOR: INCOMING GOODS  
PROCEDURE NO: P008  
REVISION NO: 0  
ISSUED: 1.9.90

8.0 DOCUMENT PATHS

Inspection tags will accompany the material from the time of inspection until the moment where the material is used.

A copy of the Incoming Inspection Report is to be kept in the Job Master File by the Q.A. Manager. A second copy is to be kept in the shop floor document holder.



P.O. Box 4049  
Christchurch  
New Zealand

**GROUP HEAD OFFICE:**  
183 Durham Street  
P.O. Box 4049  
Christchurch  
**Telephone (03) 795-750**  
**Facsimile 64 3 663-528**

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PROCEDURE NO: P009  
REVISION NO: 0  
ISSUED: 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: PURCHASE ORDER FORMS

### INTRODUCTION

In order to ascertain the quality of an item, it is important to know what materials are used in its production. These Purchase Order Procedures specify how the material is to be ordered, documentation that is necessary and what inspections are required.

### CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: PURCHASE ORDER FORMS  
PROCEDURE NO: P009  
REVISION NO: 0  
ISSUED: 1.9.90

### 1.0 SCOPE

This procedure encompasses the ordering of all goods and material by representatives of Mace Engineering Limited.

### 2.0 OBJECTIVES

This procedure identifies those occasions on which to use a Purchase Order or Purchase Requisition Order to obtain material.

### 3.0 IMPLEMENTATION

This procedure is to be implemented whenever goods/material are to be sourced from a supplier.

### 4.0 RELEVANT PROCEDURES

REF: P008 Incoming Goods Procedure  
REF: P009 Job Inspection Plan Preparation and Implementation  
REF: P010 Manufacturing System

### 5.0 PROCEDURE RESPONSIBILITIES

It is the responsibility of the Works Manager in charge of the job to complete the Purchase Requisition forms (and Purchase Orders for Non Q.A. Jobs) and to include all relevant information.

It is the responsibility of the Purchasing Officer to complete those orders as specified by a Purchase Requisition Order.

It is the responsibility of the Works Manager to forward a copy of the Purchase Order to the Q.A. Manager.

PROCEDURE FOR: PURCHASE ORDER FORMS  
PROCEDURE NO: P009  
REVISION NO: 0  
ISSUED: 1.9.90

## 6.0 METHOD

### 6.1 Procedure for Ordering Goods for a "Q.A. Job"

The Works Manager will complete a Purchase Requisition Form fully specifying all the purchase information including:

- (1) Item
- (2) Quantity
- (3) Part or serial number
- (4) Delivery instructions and date
- (5) Job card number
- (6) Heat/mill certificates
- (7) Warranty

and any other documentation deemed relevant.

The Works Manager will consult with the following people to ensure that all this information is collated.

- (1) Q.A. department representative
- (2) Other employees of Mace Engineering Limited
- (3) Client

Following completion of the Purchase Requisition form it is given to the Purchasing Officer. The Purchasing Officer will then complete a Purchase Order and consult a list of preferred suppliers to find a suitable supplier.

If no suitable supplier can be found, the Works Manager is informed and in consultation with the Q.A. Manager must decide on new purchase specifications and/or additional Incoming Inspection to certify the goods. The Purchase Requisition form is returned to the Purchasing Officer for completion.

Once a suitable supplier is found, the purchase order is completed and sent to the supplier. The Q.A. Manager is notified of the delivery date.

### 6.2 Purchase Orders for Non Q.A. Jobs

In this instance each of the Works Managers has an order book for their department. The purchase order is completed and sent to the supplier. The supplier's choice is based upon the Works Managers experience in the industry.

PROCEDURE FOR: PURCHASE ORDER FORMS  
PROCEDURE NO: P009  
REVISION NO: 0  
ISSUED: 1.9.90

7.0 PROCEDURE CHECK

The Works Manager ordering material for a Q.A. job will verify the Purchase Order prepared by the Purchasing Officer before a supplier is contacted.

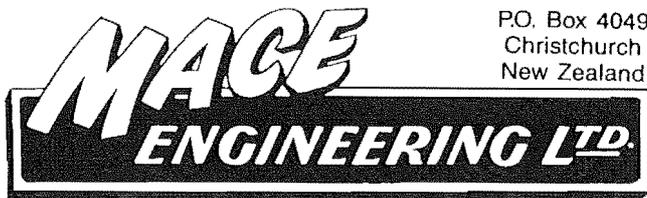
8.0 DOCUMENT PATHS

A copy of the Purchase Requisition form and the Purchase Order will be kept by the Q.A. Manager in the job master file.

A copy of the Purchase Requisition form will be kept by the Works Manager.

A copy of the Purchase Order will be kept by the Purchasing Officer.

The Purchase Order will be sent to the supplier.



P.O. Box 4049  
Christchurch  
New Zealand

GROUP HEAD OFFICE:  
183 Durham Street  
P.O. Box 4049  
Christchurch  
Telephone (03) 795-750  
Facsimile 64 3 663-528

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PROCEDURE NO: P010  
REVISION NO: 0  
ISSUED: 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: MANUFACTURING SYSTEM

## INTRODUCTION

In order to ensure the quality of goods produced, it is necessary to implement the correct planning procedures and assign the relevant documentation to the job before production, monitor and carry out these procedures and documents during production, then collate and reuse the procedures upon completion of the job.

## CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: MANUFACTURING SYSTEM  
PROCEDURE NO: P010  
REVISION NO: 0  
ISSUED: 1.9.90

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## 1.0 SCOPE

This document covers the procedure for the planning and production of a job by staff at Mace Engineering Limited.

## 2.0 OBJECTIVES

To define the responsibilities, actions and timing of personnel and machinery at Mace Engineering Limited for the production of a job.

## 3.0 IMPLEMENTATION

The procedures outlined in this document are to be implemented upon receipt of a Job Order by Mace Engineering Limited.

## 4.0 RELEVANT PROCEDURES

REF: P001	Job Instruction Plan Preparation
REF: P002	Job Inspection Plan Preparation and Implementation
REF: P003	Non Conforming Material
REF: P009	Purchase Order Forms
REF: P011	CNC File Allocation Procedures

## 5.0 PROCEDURE RESPONSIBILITIES

The Works Manager in charge of the job, in conjunction with other staff, will decide on the order of operations, machinery and material requirements, techniques and inspections.

The Works Manager will be responsible for producing the following documents.

- (1) Job Instruction Plan
- (2) Production Plan

The Q.A. Manager or his delegate will be responsible for producing the Job Inspection plan and for all in-process and final inspections.

PROCEDURE FOR: MANUFACTURING SYSTEM  
PROCEDURE NO: P010  
REVISION NO: 0  
ISSUED: 1.9.90

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## 6.0 METHOD

### 6.1 Jobs Designated "Non Q.A. Jobs"

A Works Manager will be assigned the job. The Job Card, Job Instruction/Inspection plans are completed as specified in Procedures P001 and P002. If an inspection is necessary the Works Manager will inform the Q.A. Manager who will ensure the techniques necessary to implement them are available.

The Job Instruction Plan is then implemented in the workshop. The job is completed in stages under the guidance of the Works Manager. The Works Manager orders all materials and organises the machinery and personnel requirements to ensure the job is completed. If inspection of the job is necessary the Q.A. Manager is consulted. The Works Manager will then organise packing and delivery of the completed job.

### 6.2 Method for those Jobs designated "Q.A. Jobs"

An order arrives and is designated a "Q.A. Job" by management. As most of this work will be fairly comprehensive it is likely to be the result of a quotation from Mace Engineering Limited. A Works Manager is assigned to the Job.

The next stage is the construction of documentation necessary to assure the quality of the product. This will include:

- (1) Job Instruction Plan
- (2) Job Inspection Plan
- (3) Job Card
- (4) Production Plan
- (5) CNC Programming

The order of operations, machinery and material requirements, personnel and inspections that will be detailed by this documentation are to be outlined in a planning meeting involving some or all of the following personnel.

- (1) Quotations Officer
- (2) Works Manager
- (3) Q.A. Manager
- (4) Design Department
- (5) Machine Operators
- (6) Customer

PROCEDURE FOR: MANUFACTURING SYSTEM  
PROCEDURE NO: P010  
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ISSUED: 1.9.90

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This meeting will take place before production begins on a job. The procedures for constructing the necessary documentation are outlined in section 4.0.

A final check on documentation is made before production begins. Production follows the steps indicated in the Production Plan on the Job Instruction Sheet. After each task is finished it is signed and dated by the employee before the next task is started. When an inspection is scheduled production will halt and not recommence until the inspection has been satisfactorily completed.

If the job fails the inspection Procedure P003 for non conforming material will be implemented. If the job passes the inspection it will continue through the production schedule to completion where Procedure P002 (Job Inspection Plan Preparation and Implementation) will specify the final Inspection.

After completion of the job the Works Manager will authorise packing and dispatch of the workpiece. The Production Plan and documentation will then be analysed to pinpoint any inefficiencies in the system.

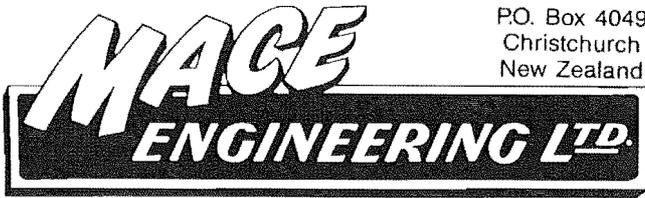
#### 7.0 PROCEDURE CHECK

The procedures and documents are verified before production commences by all the Works Managers involved in the Job. Verification of completion of manufacture and fitness for use is given by the completed Final Inspection Release prepared by the Q.A. Manager.

#### 8.0 DOCUMENT PATHS

The Works Manager and Q.A. Manager will keep copies of the Job Instruction Plan, Job Inspection Plan, Job Card and drawings. One copy of all documents will accompany the workpiece.

Any documentation generated during production will be kept as specified in the relevant procedures.



P.O. Box 4049  
Christchurch  
New Zealand

**GROUP HEAD OFFICE:**  
183 Durham Street  
P.O. Box 4049  
Christchurch  
**Telephone (03) 795-750**  
Facsimile 64 3 663-528

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PROCEDURE NO: P011  
REVISION NO: 0  
ISSUED: 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: CNC FILE ALLOCATION

### INTRODUCTION

With the increasing use of CNC machinery in the production process, comes a corresponding increase in data storage and manipulation. This procedure details the information generated for CNC machinery and how it is stored and presented.

### CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: CNC FILE ALLOCATION  
PROCEDURE NO: P011  
REVISION NO: 0  
ISSUED: 1.9.90

### 1.0 SCOPE

This procedure describes the creation and storage of the programs for Mace Engineering Limited's CNC machinery.

### 2.0 OBJECTIVES

This procedure will describe how and where CNC programs are stored, what information is contained in them and the process of how they are loaded onto each machine.

### 3.0 IMPLEMENTATION

This procedure is implemented for each new job scheduled to be performed on CNC machinery.

### 4.0 RELEVANT PROCEDURES

REF: P001 Job Instruction Plan Preparation  
REF: P010 Manufacturing System

### 5.0 PROCEDURE RESPONSIBILITIES

It is the responsibility of the NC Programming Manager to create, store and modify all NC programs for computer operated machinery.

### 6.0 METHOD

1. Determine machinery to be used.
2. Allocate file name - the file name is allocated based on the machine being used, the first letter of the customer's name and a number.  
Each machine has two books for recording program numbers.  
Book 1: Is numbered in sequence, to indicate the last number that has been used.

PROCEDURE FOR: CNC FILE ALLOCATION  
PROCEDURE NO: P011  
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Book 2: Lists Book 1's programme number into the customer directories.

e.g. A job for Firestone to use the LC30 Lathe, last number in Book 1 is 499.  
Book 2 will list: Customer's name, component and drawing number, operations and file name. File name will be F500LC30.

3. The number of operators on each machine are determined.
4. Setup sheets for each operation are prepared:  
These sheets list - customer  
component  
drawing no. & rev.  
machine  
material  
file name  
tooling required
5. A copy of the setup sheet is filed alphabetically in the CNC Department.
6. A folder for each customer is prepared containing the setup sheets - contents are listed on the cover.
7. The colour code for folders is as follows:  
LC30 - CNC Lathe - Green  
MCV3 & MCV8 - Vertical Machining Centres - Orange  
MCH8 - Horizontal Machining Centre - Yellow  
FS6T - Vertical Borer - Blue  
VMP8 - 5 Axis - Red
8. Folders are stored alphabetically in the CNC Department
9. The Job is programmed. Upon completion the job is listed on the office board corresponding to the machine required. This listing purpose is to indicate workload and priority.
10. Priorities are assessed through consultation with the Works Managers. When they have been decided, the setup sheets are loaded into boxes outside the CNC office for machine operators to collect when required.
11. Files are loaded into the factory network for each machine to download when required.
12. On completion of the job the operator returns the setup sheet to the "Return Box". This is then collected and filed and the job is removed from the work list.

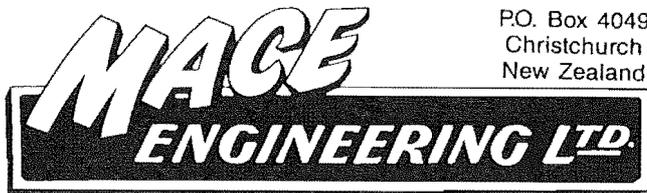
PROCEDURE FOR: CNC FILE ALLOCATION  
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REVISION NO: 0  
ISSUED: 1.9.90

#### 7.0 PROCEDURE CHECK

The NC Programmer will ensure that the setup sheets contain the necessary information to ensure the correct setup and machining of the workpiece on the NC machinery. The machine operator will verify that all toolbits, setup sheets, computer files etc., are available before work commences.

#### 8.0 DOCUMENT PATHS

A copy of the setup sheet is given to the machine operator before starting the job, one copy is to be kept by the NC programmer and, when a "Q.A. Job" is being machined, a copy is to be forwarded to the Q.A. Manager. All computer files, programmes or tapes generated will follow a backup procedure.



P.O. Box 4049  
Christchurch  
New Zealand

GROUP HEAD OFFICE:  
183 Durham Street  
P.O. Box 4049  
Christchurch  
Telephone (03) 795-750  
Facsimile 64 3 663-528

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PROCEDURE NO: P013  
REVISION NO: 0  
ISSUED : 1.9.90

PREPARED BY: A. SHAW  
REVIEWED BY: V.B. GILES  
AUTHORISED BY:

PROCEDURE FOR: CALIBRATION OF MEASURING INSTRUMENTS

#### INTRODUCTION:

To ensure Mace Engineering Limited's manufactured product accurately reflects the tolerance of the customer's drawings, it is necessary to calibrate measuring instruments in the workshop and inspection room and show that these instruments are calibrated to an approved standard at all times.

#### CONTENTS

- (1) SCOPE
- (2) OBJECTIVES
- (3) IMPLEMENTATION
- (4) RELEVANT PROCEDURES
- (5) PROCEDURE RESPONSIBILITIES
- (6) METHOD
- (7) PROCEDURE CHECK
- (8) DOCUMENT PATHS

PROCEDURE FOR: CALIBRATION OF MEASURING INSTRUMENTS  
PROCEDURE NO: P013  
REVISION NO: 0  
ISSUED: 1.9.90

## 1 SCOPE

This procedure covers how the calibration of all Mace Engineering's measuring equipment is to take place and the system that is used to ensure all measuring equipment is periodically checked.

## 2.0 OBJECTIVES

This procedure describes how each instrument is to be calibrated, how to recognise a calibrated instrument and how to ensure that all Mace Engineering Limited's measuring instruments are fit for use.

## 3.0 IMPLEMENTATION

This procedure is implemented when a measuring instrument is to be calibrated.

## 4.0 RELEVANT PROCEDURES

REF: P002 Job Inspection Plan Preparation and Implementation

## 5.0 PROCEDURE RESPONSIBILITIES

It is the responsibility of the Q.A. Manager or a suitably qualified delegate to calibrate all measuring equipment used at Mace Engineering Limited. Where the techniques to calibrate some equipment do not exist at Mace Engineering Limited, the Q.A. Manager will ensure the equipment is forwarded to a recognised authority for calibration.

It is the responsibility of the Q.A. Manager to implement the calibration system outlined in this procedure.

## 6.0 METHOD

### 6.1 Measuring Equipment

All measuring equipment (verniers, micrometers - internal, external and depth, etc.) are engraved with a "MACE" identification number upon purchase. If the instrument has box or similar housing, this will also have the "MACE" number prominently displayed.

PROCEDURE FOR: CALIBRATION OF MEASURING INSTRUMENTS  
PROCEDURE NO: P013  
REVISION NO: 0  
ISSUED: 1.9.90

Each instruments' characteristics are recorded on a standard "Mace Engineering Equipment Inspection Sheet". Each individual sheet contains the following information.

- (1) Equipment description.
- (2) Brand name.
- (3) Mace No.
- (4) Model No.
- (5) Serial No.
- (6) Purchase date.
- (7) Supplier.
- (8) Area the instrument is assigned to.
- (9) Calibration history of the instrument.

## 6.2 Calibration of Measuring Equipment

All measuring equipment used in frequent and general use will be calibrated periodically. Those instruments used infrequently will be calibrated at the discretion of the Q.A. Manager.

Every six months all the micrometers, verniers and other general measuring equipment will be given a visual examination and checked for damage. The micrometer is then checked at its zero point for accuracy. If this is acceptable, the instruments' inspection sheet is stamped with the word "CHECKED" and the date, the inspection officer then signs the sheet.

If the inspection shows the instrument is inaccurate, it will be checked as specified in the appropriate standard:

- |                                     |                           |
|-------------------------------------|---------------------------|
| (a) External micrometers            | BS870:1950 or AS2102-1989 |
| (b) Depth micrometers               | BS6468:1984               |
| (c) Precision vernier calipers      | BS887:1982                |
| (d) Precision vernier depth gauges  | BS6365:1983               |
| (e) Precision vernier height gauges | BS1643:1983               |

All inspections are performed at a standard temperature of 20 degrees C.

All instruments will then be re-calibrated by the Q.A. Manager or his delegate. Where Mace Engineering cannot repair the instrument, it will be sent to an authorised body for repair. After repair it will be subject to a full inspection before being released to the workshop for use.

PROCEDURE FOR: CALIBRATION OF MEASURING INSTRUMENTS  
PROCEDURE NO: P013  
REVISION NO: 0  
ISSUED: 1.9.90

All information pertaining to inspection and repair of measuring equipment is to be stored on the "Mace Engineering Equipment Inspection Sheet".

### 6.3 Calibration System

A calibration system is in operation on the premises of Mace Engineering Limited. Its structure is as follows:

All measuring equipment in frequent use is re-calibrated every six months, at this time it is affixed with a red (first 6 months of the year) or blue (last six months) sticker. This sticker shows that the instrument has been calibrated. To ensure only calibrated instruments are used for each period, either blue or red squares are hung at designated sites around the factory. Equipment users are therefore able to ascertain whether the instrument is calibrated or not. If the instrument has a different colour sticker to that on the wall, it cannot be used and is taken to the Q.A. Manager for re-calibration.

For a period of approximately one week, both squares will be visible during the transition period from one colour to the other. This is to allow for the inspection of all measuring equipment. During this period, equipment with both colour stickers will be allowed to be used. Once all the inspections are finished, a single colour square will be visible.

If an instrument is dropped, damaged, suspected of inaccuracy or needed for a particularly accurate measurement, it should be taken to the inspection room without delay. This is regardless of the colour of the sticker.

Every two years the calibration system is reviewed and, on the basis of the inspection records (i.e. how many instruments had to be adjusted at the end of the period), a decision will be made to either increase or decrease the interval between calibration inspections.

### 7.0 PROCEDURE CHECK

The Q.A. Manager will verify the inspection of test equipment by recording all data on the "Mace Engineering Equipment Inspection Sheet".

PROCEDURE FOR: CALIBRATION OF MEASURING INSTRUMENTS  
PROCEDURE NO: P013  
REVISION NO: 0  
ISSUED: 1.9.90

The Q.A. Manager will ensure only calibrated instruments are used by changing the coloured indicator squares when inspections are completed and visually checking all instruments when in the workshop.

#### 8.0 DOCUMENT PATHS

The Mace Engineering Equipment Inspection Sheets for all measuring instruments will be kept by the Q.A. Manager.